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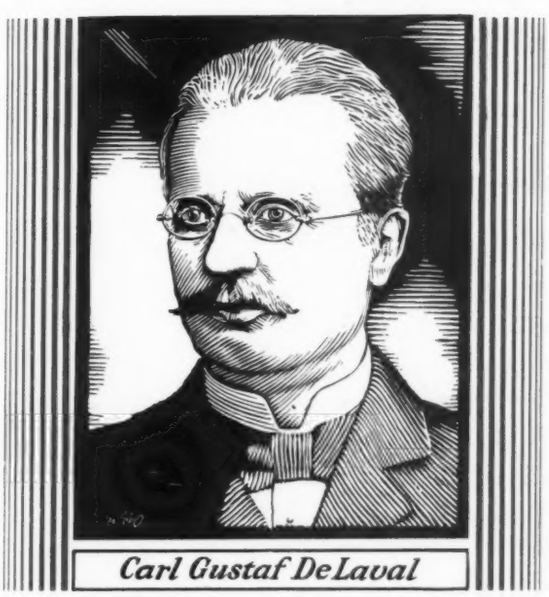
DECEMBER 1933

MACHINE DESIGN



Carl Gustaf De Laval

AS IT AFFECTS

ENGINEERING—PRODUCTION—SALES

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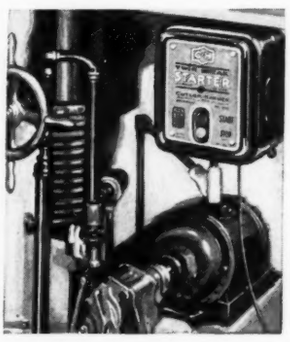
Standardize on Cutler-Hammer Motor Control to insure the performance of your machines and to add another sales feature at no expense. You, too, should call in C-H engineers while designs are in the blueprint stage. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus,* 1310 St. Paul Ave., Milwaukee, Wis.



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(A-8035)

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CALENDAR OF MEETINGS AND EXPOSITIONS

Jan. 6-13—National Automobile Show Thirty-fourth annual exhibition of new designs in automobiles, materials and parts to be held at Grand Central Palace, New York. Exposition is sponsored by National Automobile Chamber of Commerce located at 366 Madison avenue, New York.

Jan. 8—Society of Automotive Engineers. Annual dinner to be held in New York in conjunction with automobile show. John A. C. Warner, 29 West Thirty-ninth street, New York, is general manager of the society.

Jan. 9—Mining and Metallurgical Society of America. Annual meeting to be held at New York. Percy E. Barbour, 75 West street, New York, is secretary of the society.

Jan. 19-27—National Power Boat Show. Annual exhibition of power boats, engines. parts and accessories to be held at Grand Central Palace, New York. Information on the show may be obtained from National Association of Boat and Engine Manufacturers, Graybar building, New York.

Jan. 22-25—Society of Automotive Engineers. Annual meeting which will include a program of technical papers to be held in Detroit. John A. C. Warner, 29 West Thirty-ninth street, New York, is general manager of the Automotive society.

Jan. 23-26—American Institute of Electrical Engineers. Annual meeting to be held at Engineering Societies building, New York. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary of the institute.

Feb. 5-8—American Society of Heating and Ventilating Engineers. Annual meeting to be held at Hotel Biltmore, New York. A. V. Hutchinson, 51 Madison avenue, New York, is secretary of the society.

Feb. 5-9—International Heating and Ventilating Exposition. Third annual exhibition to be held at Grand Central Palace, New York, will include exhibits of units for heating, ventilating and air conditioning, materials, automatic switches and controls, thermostats, valves, burners designed to operate with gas, oil, solid fuels and electricity, fans, air filters, humidifiers, and similar apparatus and parts. Charles F. Roth, Grand Central Palace, New York, is manager of the exposition.

Feb. 19—Technical Association of the Pulp and Paper Industry. Annual meeting and exposition to be held at Waldorf Astoria hotel, New York, R. C. Macdonald, 370 Lexington avenue, New York, is secretary of the association.

March 5-9—American Oil Burner association. Eleventh national oil burner show to be held at Commercial Museum, Philadelphia, will include operating exhibits. Annual meeting of the association to be held at Benjamin Franklin hotel, Philadelphia. Harry F. Tapp, 342 Madison avenue, New York, is secretary of the association.

March 13-16—Fourth Packaging, Packing and Shipping Exposition. Annual display of equipment for modern packaging, packing and shipping to be held under the auspices of American Management association at Hotel Astor, New York, will include exhibits of materials, packaging equipment, machinery and supplies including bottle filling. gum taping, wire stitching and sealing machines, also packing and shipping room accesssories, transportation and delivery essentials. John G. Goetz, 20 Vesey street, New York, is managing director of the management association.

March 26-30—American Chemical Society. Semiannual meeting at St. Petersburg, Fla. Dr. Charles L. Parsons, 728 Mills building, Washington, is secretary of the society.

MACHINE DESIGN
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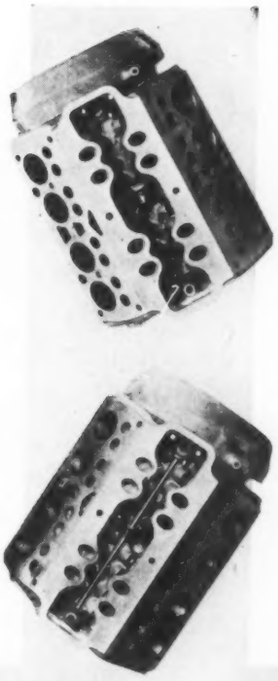
Hydraulics Aids Simplification



Harold B. Veith
Associate Editor, Machine Design

ENGINEERS are turning to hydraulics to give them flexibility of control that otherwise could not be obtained. As brought out in the October issue, page 25, the development of pumps and valves for this work has been a valuable aid to the designer.

One case in point is a machine, Fig. 1, developed recently to drill and ream three holes simultaneously in the three bosses of a V-type internal combustion engine cylinder block and then insert an oil distributing tube. Operation is continuous, and five cylinder blocks are handled at the various stations of the machine at one time. Six stations in all are provided, No. 1 for loading, Nos. 2, 3 and 4 for drilling 35/64-inch holes in the bosses; No. 5 for reaming and No. 6 for inserting the tube. In indexing the blocks, absolutely correct register must be provided. A clamping device holds the casting firmly in place at the drilling, reaming and tube inserting stations.

Fig. 1—Complicated mechanisms were eliminated by the use of an hydraulic system in a machine to insert main bearing oil tubes in V-type cylinder blocks such as those shown at the top of the illustration

In view of the forego-

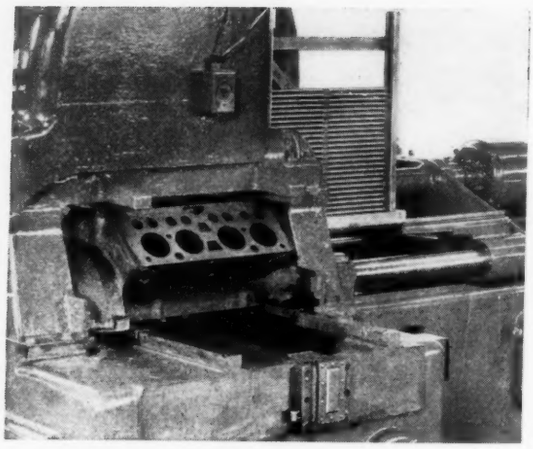


Fig. 2—Discharge end of machine depicting magazine from which oil tubes are fed

ing it is not difficult to see why mechanical mechanisms alone would not afford a simplified system of variable feeds, drill guides, clamps, etc., all brought into operation at predetermined intervals. Hydraulics offers the opportunity for simplicity in design, besides providing cushioning effects, flexibility and ease of control.

After having decided in favor of hydraulic operation, the engineers of Hammond Mfg. Co., Cleveland, builders of the machine, endeavored as far as practicable to follow the principle of unitization. Thus the machine is in reality three distinct units, supplemented by a pumping station, on which are mounted two motor-driven pumps, Fig. 1, of the combination type. Whenever pressure is built up in the system the high capacity, low pressure side of the pump is disconnected automatically and the full load is carried by the low capacity, high pressure side of the unit. This arrangement permits the use of a motor of considerably lower horsepower for each pump.

Drills Operate Simultaneously

The main body of the machine on which the engine blocks are indexed carries a superstructure embodying the actuating mechanisms for the drill guides, reamer bushing and clamping devices. Drilling stations, of which there are three, are operated as a unit. This holds true also for the reaming station and tube inserting device, these coming into action simultaneously. The three drills are of different length in accordance with the distance of each boss from the front of the casting.

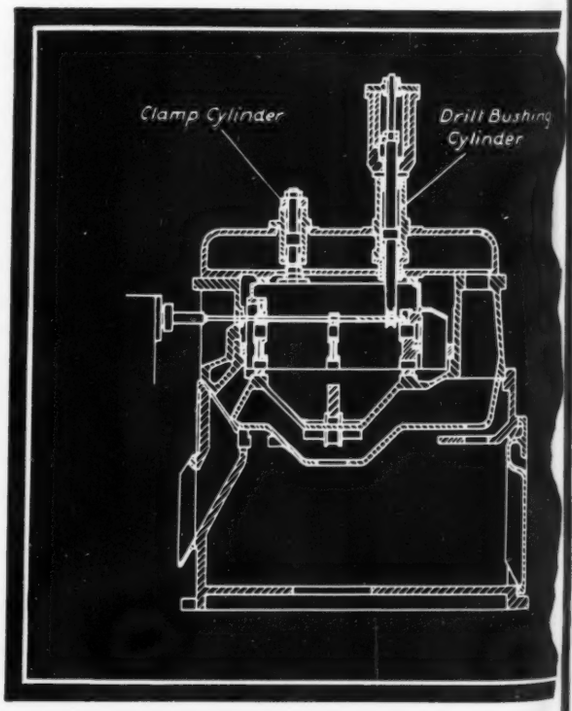
All drills and the stepped reamer are driven by individual electric motors that run continuously. Two separate heads on which these are mounted are traversed into and out of operating position on cylindrical bars. The bar type of slide was selected to overcome the handicaps of the conventional type by providing in case of wear, a means for returning the drill and reamer spindles readily to their original accurate alignment.

Incorporated in the design of each slide, Fig. 2, are two stationary hardened and ground steel guide bars on which reciprocate hardened bushings mounted in the two oscillating heads carrying the drill motors and spindles, the reamer and the tube inserting device. Oil seals at the outer ends of the bushings prevent escape of lubricant. In this connection the designers have provided an unusual construction to enable lubricant to be delivered to the guide bars. These bars receive oil directly from the reservoirs in which the spindle gear trains run, the bars constituting the bottom closure and base of the reservoirs.

Hydraulic Cylinder Employed

Cylinder block castings to be machined are delivered to the unit by a conveyor and are picked up by the transfer mechanism. The indexing mechanism shown in Fig. 3 employs an hydraulic cylinder, the piston of which is connected to a flat bar that feeds the castings forward. When the bar is moved, as hydraulic pressure actuates the cylinder at the proper interval, indexing dogs push the blocks along hardened and ground ways on the bed of the machine to the subsequent station.

In order that each block will be located prop-



erly in its respective station a series of dowels connected by linkage to a common movable bar is provided. Before operation of the various mechanisms commences these dowels must register with holes in the bottom of the casting. The movable bar controlling the dowels is actuated by the piston of a cylinder, Fig. 3, also connected with the hydraulic system. An auxiliary valve is opened when all dowels are in correct operating position. If for any reason any one of the dowels cannot seat itself, the machine stops.

Fig. 5 depicts the layout of the hydraulic pipe lines for controlling the various mechanisms. Line 1 carries pressure from pump *A* which is driven by a 5-horsepower motor at 1200 revolutions per minute, while line 2 is the pressure artery from pump *B*, driven by a 3-horsepower motor at the same speed. Line 3 is the return to the fluid tank. The larger pump furnishes pressure for the reaming and tube-pressing slide and the two corresponding block clamps as well as for the indexing mechanism; the smaller pump handles the remainder of the system. Pumps being combination units, pressure is built up when the pressing operation commences, bringing the high pressure side of the pump into operation.

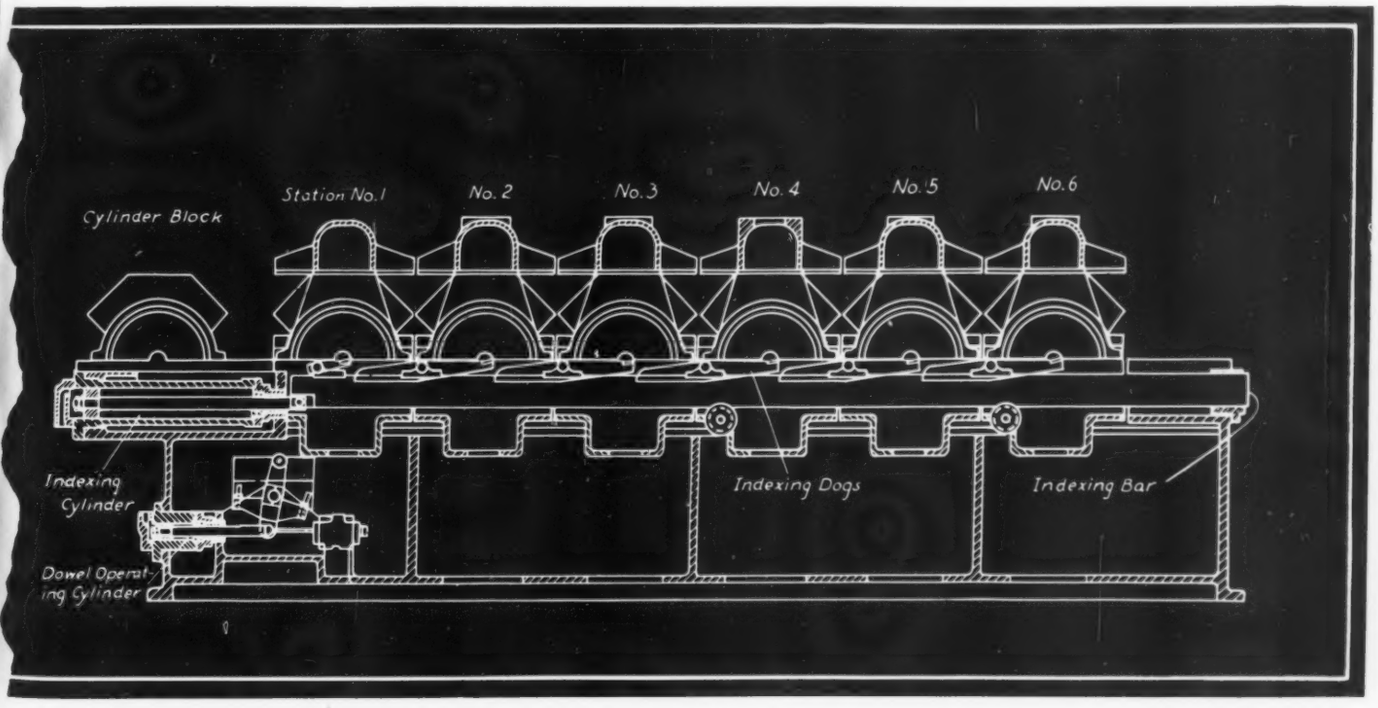
Another problem in laying out the hydraulic system, Fig. 5, arose when it became necessary to choose the beginning of a cycle. The solution was controlled by the fact that in order to prevent any complications in the sequence of operations in case of tool breakage, it was necessary to end the cycle at the return of the slides to their outward position. If it should be essential to withdraw the slides in such an emergency the machine will come to a stop and the sequence of operations is in no way disturbed.

When the operator throws the lever of valve *C* in a counterclockwise direction in starting the machine, clamps and drill bushings rise. The cylinders which control these two mechanisms are shown in Fig. 3. Completion of this operation causes the dowels to be withdrawn. When this is consummated the work is indexed, which in turn causes the dowels to be inserted and subsequently the clamps and bushings to be lowered into place. The slides then automatically advance rapidly toward the work.

Reaming Operation Explained

In order to show the manner in which the holes are machined, attention is drawn to the reamer station illustrated in Fig. 4. Three reaming surfaces are provided on the tool, one for each boss. As the tool enters the hole in the first boss of the cylinder block the feed of the slide is about three inches per minute. However, as soon as the reaming operation of that hole is completed the speed is increased sharply until the forward reaming section reaches the hole in the second boss and at the same time the second reaming section reaches the hole in the first boss; similarly for the third position. This change in feed is effected by the arrangement

Fig. 3—Cylinder blocks are indexed from one station to another and are clamped hydraulically



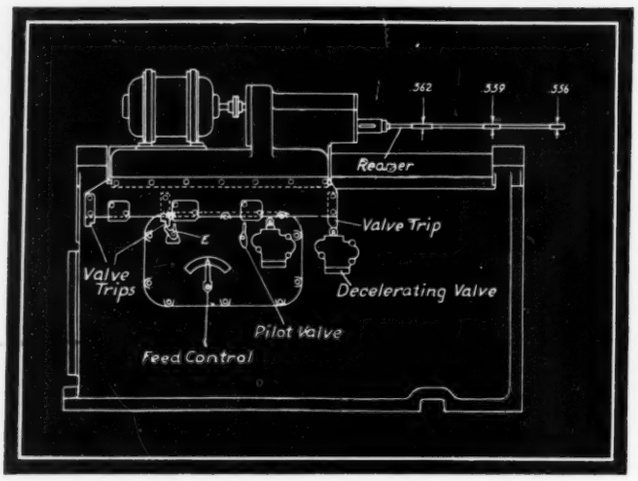


Fig. 4—Valve trips and dogs mounted on the skirt of reaming slide table control units in sequence

of three stop plates bolted to the apron of the slide bed. As the reamer is accomplishing its work one of the plates engages the plunger of the actuating valve. This causes fluid in the lines to be bypassed through the feed control valve, thereby reducing the traverse rate of the slide. When the plate disengages the roller on the plunger of the actuating valve, the higher speed is resumed. As soon as the tool has reached its predetermined depth the slide is returned automatically, this being effected when the valve trip on the rear of the slide comes into contact with the finger of the pilot valve.

As a safety measure, valves *D* and *E*, Fig. 5, are connected in series so that pressure is available only at starting valve *C* when both slides are back. Thus the normal sequence of operation cannot be altered accidentally when the tools, clamps, etc., are in the operating position. Valve *E* is actuated by a dog or trip on the apron of the reciprocating slide at the beginning and end of each cycle, as shown in Fig. 4.

In an emergency both slides carrying the drills and reamers can be returned by manually throwing valve *F* in a counterclockwise direction. Pressure on the dowels can be released by shifting valve *G*, thereby opening the pressure lines to the tank. The indexing mechanism can be operated repeatedly without advancing the slides if the valve *C* is rotated in counterclockwise direction after valve *H* has been set in counterclockwise position. Slides can be advanced without indexing by rotating valve *F* in a clockwise direction.

As explained earlier, the oil tube inserting mechanism is carried on the same slide that holds the reamer. These tubes are racked one above the other in a magazine, Fig. 2. Each time the slide returns to its starting position the bottom tube is allowed to drop into a channel below the tube carriage. When the slide again moves forward into operating position a pick-up which travels with the slide engages the end of the tube and forces it through the drilled and reamed holes in the engine block. The tube is knurled at the ends and in the center, to correspond with the bosses. Thus after it has been forced into place it is held tightly by what constitutes a press fit.

All operating controls of the machine are centralized to enable the operator to assume a strategic position where all functions can be observed.

Hydraulics Has Wide Possibilities

From the foregoing it is apparent that the embodiment of hydraulic devices was the most simple solution to problems encountered in the design of this particular machine. Wider use of this flexible source of energy and power by designers of machinery is indicative of the need for dissemination of comprehensive data on hydraulic applications. Moreover, engineers are finding it imperative to study the factors involved in considering the use of hydraulics. With this interest prevailing there is no doubt that the future will bring forth more and more outstanding examples of its use in design.

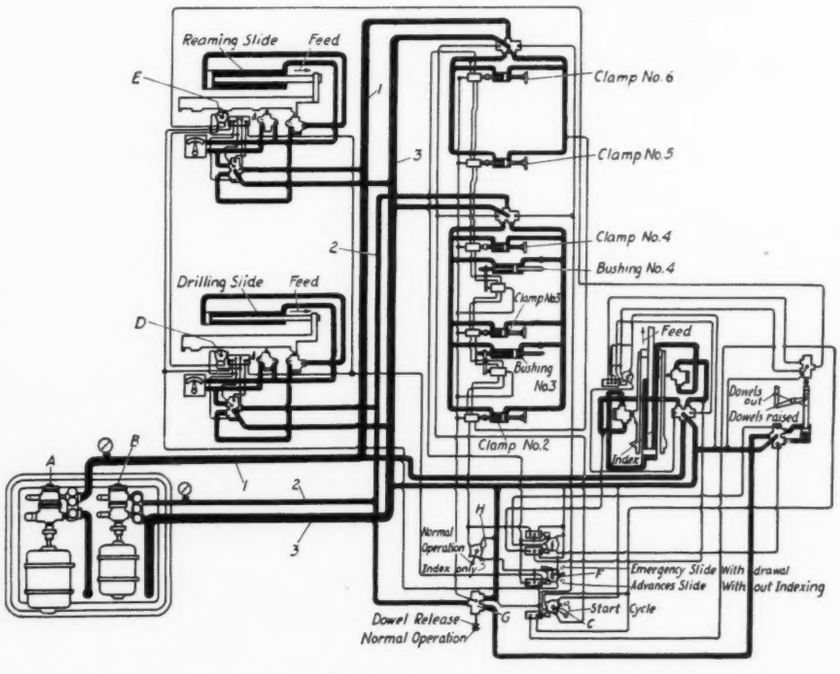


Fig. 5—Piping system conducts fluid to valves as operations proceed

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Monovalve Facilitates Compactness

DEVELOPMENT of an idea that was originated by Diesel has recently been incorporated in an American engine. Reference is made to the single valve which while similar in principle has been considerably refined. One of the early commercial applications was in the French Mono-Soupape aero engine. American

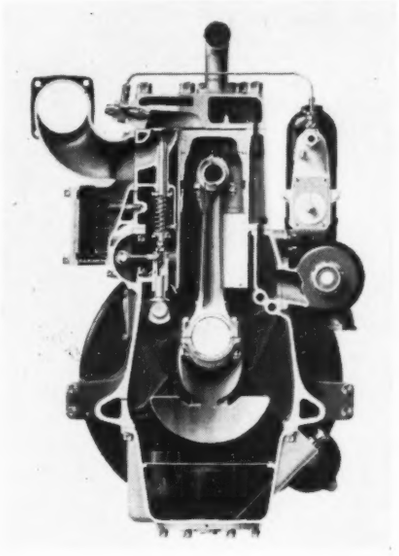


Fig. 1—By employing one valve per cylinder the designers of this deisel engine were able to utilize L-head construction, which is conceded to be the most compact and simple type of engine design

Diesel Engine Co., Oakland, Calif., in embodying a single valve in its new unit, Fig. 1, has made possible the use of an L-head rather than valve-in-head construction.

If the combustion space of a diesel must be broad enough to include two valves side by side it becomes so flat that difficulty arises in attempting to serve it with a single fuel nozzle of any conventional type. By employing one valve the American engine is provided with a combustion chamber of favorable form; also the simple valve gear is lubricated from the crankcase splash and is more or less self-compensating as to mechanical clearance with change of engine temperature, which are virtues of L-head design.

Venturi construction used on the intake and exhaust manifolds tends to create a clean air seal between the incoming air and exhaust gases. On the exhaust stroke the spent gases are discharged at high velocity through the open valve port into the venturi-formed exhaust pipe on the upstroke of the piston. A vacuum is formed on the intake side of the manifold, which is broken by a rush of air under atmospheric pressure through the porous air filter element and upward into the exhaust pipe. As the piston starts down on the intake stroke, a vacuum is created at the valve port.

Vertical Sleeve Combats Leakage

SOME interesting designs have emanated from engineers' efforts to overcome the possibility of oil leakage. Euclid Gear Corp., Cleveland, adds another idea to the list, employing it on vertical speed reducers. The arrangement, Fig. 2, combats leakage through the medium of a bronze sleeve inserted in a clearance recess between the low speed gear and low speed shaft. Mounted rigidly in the casing of the reducer at the bottom, the sleeve extends into the recess

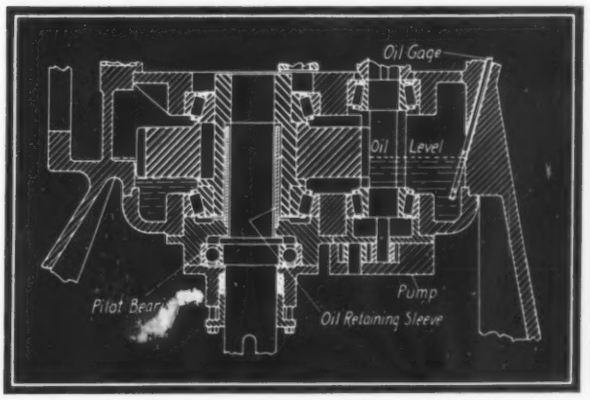


Fig. 2—Bronze sleeve between gear hub and shaft prevents oil leakage in vertical unit

above the level of oil in the unit in a somewhat similar way to the extended shaft mounting for the water agitator in domestic washing machines. Care is of course taken in the gear reducer to allow sufficient space between the gear and sleeve to avoid carrying-up of oil by capillary attraction.

A ball bearing is placed outside the roller bearings that carry the actual gear loads, serving as a pilot bearing for the low speed shaft. This eliminates deflection at the point the shaft is secured to the extended hub of the gear. Lubrication of the unit is furnished by the pressure oil pump shown at the right of the drawing, the total amount of oil in the system being regulated to give the maximum oil level indicated. An auxiliary pressure grease gun fitting is used to conduct lubricant to the pilot ball bearing, this grease being retained by a conventional packing gland.

Operation by Magnetic Influence

MAGNETICALLY operated, a new treadless switch has been developed which when placed in the path of an auto, truck, tractor or other vehicle built of iron or steel, will operate doors, danger signals, etc. No physical contact is necessary because the operation depends on magnetic influence; therefore human beings, animals, or nonmagnetic objects do not affect it. The unit, distributed by Tiffin Electro-Mechanical Co., Tiffin, O., is designed for floor or road installation.

An Abrasive Blast Without Air

BY INGENIOUS application, the centrifugal principle now is encroaching on the field compressed air has held in the cleaning of metal surfaces. With the new idea, abrasive is administered by force created in a whirling mass. The method as well as the mechanical design is simple. A wheel or drum, Fig. 3, is employed; abrasive is fed into it by gravity from a storage hopper; the rapid rotation of the wheel causes the abrasive to be ejected from slots in the rim with a tremendous force. This stream of material is directed on to the work to be cleaned. The airless wheelabrator, as the unit is known, is manufactured by American Foundry & Equipment Co., Mishawaka, Ind., and offers a revolutionary cleaning method.

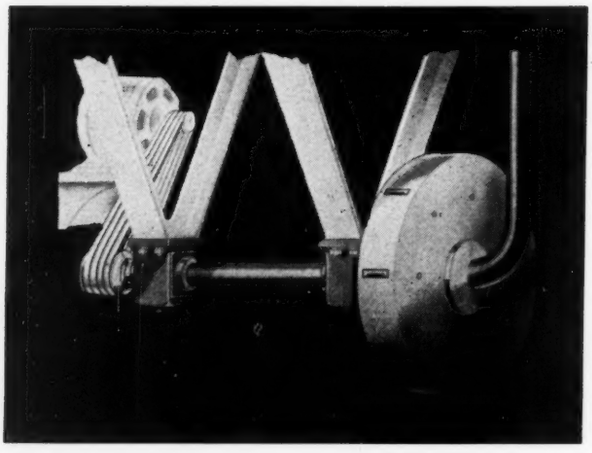


Fig. 3—Centrifugal force ejects abrasives from slots in a motor operated drum

Miller Employs Offset Principle

EVOLUTION of an idea in milling culminated into what is known as the offset principle; in short, the work holder is set eccentric to the cutter and the depth of cut is regulated by varying the distance of the offset. The idea is conceived by engineers of The Oesterlein Machine Co. is depicted in the drawings, Figs. 4 and 5, which show respectively the use of a three-unit work-holding fixture and the continuous milling of many parts.

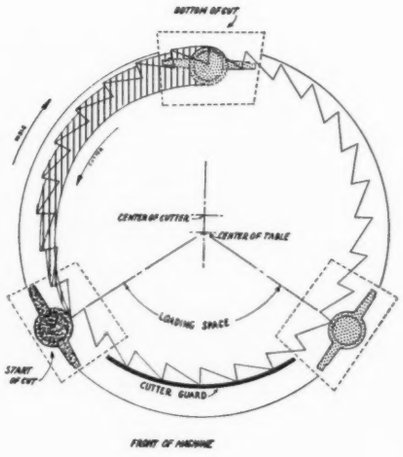


Fig. 4—Principle of offset milling is carried out by setting the work holder eccentric to the cutter. Depth of cut is regulated by varying the distance of offset

In offset milling, standard round milling cutters are employed. They are surrounded completely by parts to be milled, but the center of the work table which revolves around the cutter is offset an amount sufficient to mill to the proper depth. Parts thus move in a planetary fashion around the cutter, coming into the range of cutter action in the course of their orbit and moving closer and closer to the center of the cutter spindle until the orbits of cutter teeth and work become tangent and feeding ceases, this being the end of the cut. Continuing in their circular path, parts then recede on the other side of the spindle and when they have

cleared the cutters sufficiently, are removed and the fixture is reloaded.

Generally speaking increased productivity of offset milling as discussed in the foregoing is due to the fact that non-productive time has been eliminated and a greatly increased arc of the cutter is in productive operation at all times.

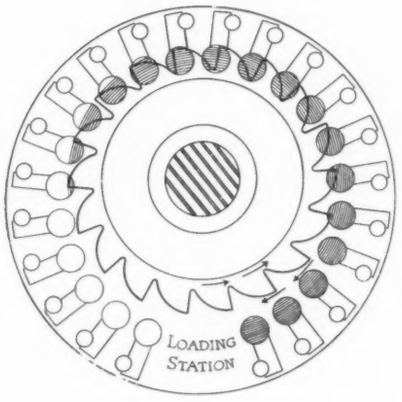


Fig. 5—Arrangement of parts for continuous milling. Carried in a circular path, parts come into range of cutter action until at the end of the cut the orbits of cutter teeth and work become tangent to each other

Polarized Light Tests Glass

STRAIN is glass now can be studied by a new polariscope, a device which is destined to have far-reaching effects. The use of the Bausch & Lomb unit will reveal the location of strain in a glass object and assist in remedying the trouble. A brief discussion of how strains are viewed shows that well annealed glass has no effect on polarized light; thus light passes through without a change. A strained piece of glass, however, is no longer optically homogeneous, and a beam of polarized light passing through is broken up into two rays. When these emerge one is held back more than the other and is "out of step." This causes interference which is made visible to the eye as alternate light and dark bands. These weak contrasts are built up purposely to brilliant colors by another optical device, known as a retardation plate, which permits making estimates of the amount of strain as well as revealing the area in which it occurs.

Saving Space by Using the Camera

ANOTHER use for the camera! We may soon find it common to read newspapers, magazines and books through the use of films. The announcement brings to mind the talk given recently by Dr. William F. Ogburn, University of Chicago, on the recording of words of a book on a spool of magnetized wire (M. D., June, p. 41). That device and the more recent use of the camera are indicative of the amount of thought that is being given to inventions for saving storage space; books are accumulating rapidly and in spite of their compactness, libraries find additional space needed each year.

This latest invention to promise a solution to the problem was made public recently in Chicago by Charles Z. Case of the Eastman Kodak Co. The camera employed can photograph more than eight full size newspaper pages on a strip of film 1⅜ by 12 inches, and a month of fifty-page papers on a single reel less than 4 inches in diameter. The film thus prepared can be read in newspaper offices or public buildings on a simple viewing device by which the small page images are enlarged to half again the size of the original newspaper.

Designing for Safety in Tires

DISTINCTIVE changes are taking place in transportation. Here perhaps lies one of the most fertile fields for ideas. Look at the new railmobile. Three large companies, Fairbanks, Morse & Co., Goodyear and Chrysler contributed the services of members of their engineering staffs to form an engineering pool. The result was the railmobile, resembling closely the conventional auto except that the wheels are adapted to rail travel.

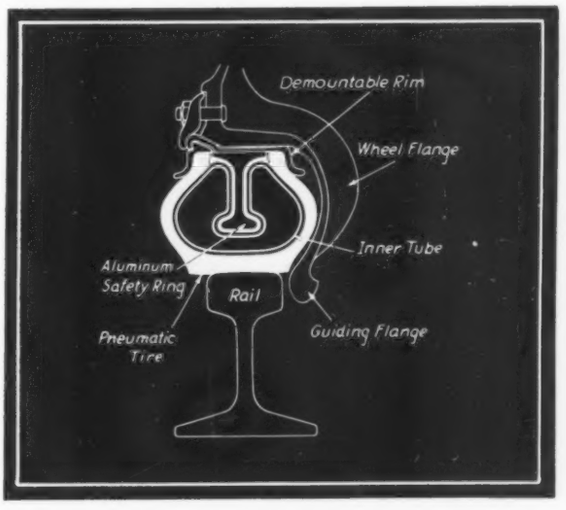


Fig. 6—An aluminum ring is employed as a safety feature in pneumatic tire for rail use

High pressure pneumatic tires are used on the wheels. Safety and heat dissipation difficulties were solved by the use of an aluminum alloy safety ring secured to the wheel rim and within the tire, Fig. 6. In addition, if a blow out or puncture should occur there is no danger of the vehicle leaving the track. Deflation of the tire results in a dropping of only ⅝-inch, but the wheel continues to ride the rail.

Simplified Calculations Unshackle the

By Joseph Harrington Jr.

FOLLOWING the general discussion of the problems of force analysis in dynamic mechanisms and the specific investigation of parts which rotate about a fixed pivot, in the October and November issues, attention is now drawn to parts which do not rotate about fixed pivots. These pieces will be called flying parts, as no point in them is connected to the frame by a pivot. As is well known, any motion may be reduced to a rotation about a point called the center of velocity (C_v). This point moves in relation to the piece and in relation to the frame of the machine, but for any instant it has all the properties of a fixed pivot. It can be located easily if the direction of motion of two points in a piece is known. Draw lines through these two points perpendicular to their velocity vectors, the velocity vector always being perpendicular to the radial line. These two lines intersect at the only point which lies on both of them, hence it is the instantaneous center of rotation.

Application Is Illustrated

Fig. 1 shows the application of this principle to the determination of the instantaneous center of two commonly occurring types of parts, a four-bar linkage and a crank and connecting rod.

The same formulas for deriving the velocity of B from that of A apply here as in the fixed pivot pieces. $B_v = A_v \times BO/AO$. Also the same

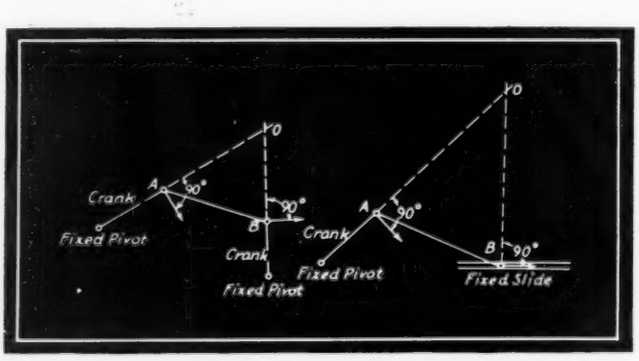


Fig. 1—A four-bar linkage and a crank and connecting rod present a typical force analysis problem

graphical method applies. When point O falls off the paper or so far away as to make the scale of the drawing too small, recourse can be had to the fact that the velocity component along the member must be the same at both ends. As shown in Fig. 2, we take the component of A_v along AB, which is AC. This is transferred to BD. Then DE is drawn perpendicular to BD until it intersects the direction of B_v. This gives us B_v.

Next the acceleration of B must be found

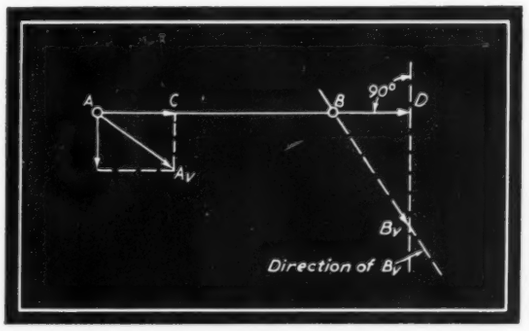


Fig. 2—Velocity component along the member must be the same at both ends

when that of A is known. As is well known, if K and L are two related points moving in space, and the acceleration k of K with respect to L is known, and the absolute acceleration l of L is known, then the absolute acceleration of K is equal to the vectorial sum of k and l. The piece AB is rotating about the instantaneous center C_v, so that points A and B are accelerated towards C_v and tangential to it, just as in the case of fixed pivot parts. But C_v also has an acceleration d, so that the acceleration of A, for instance, is A_n and A_t (with respect to C_v) plus d. But fortunately we know what this is. It is A_a as transferred from the previous piece, where it was called B_a.

Can Compute Quantities

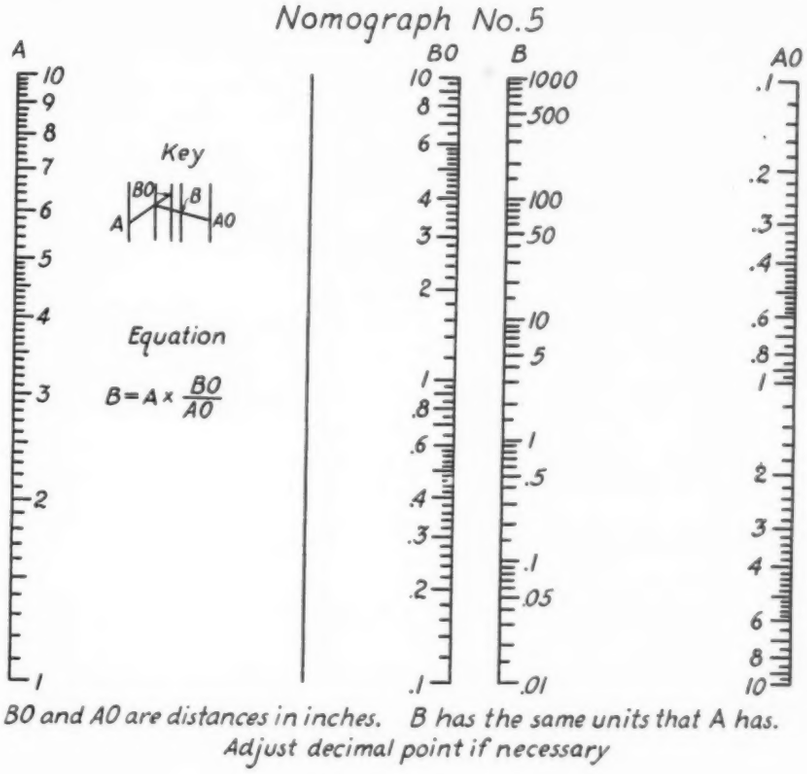
Of the quantities mentioned, we know A_a from the previous member and we can calculate A_n with respect to C_v from A_v and AC_v:

$$A_n = (A_v)^2/(AC_v)$$

d in general is unknown. Therefore we must

ckle the Designer

—Part III—



find A_t with respect to C_v. This is calculable from

$$A_t = \alpha \times (AC_v)$$

if α is known. The only way to get α is from the differential definition $\alpha = d\omega/dt$, or what is more convenient

$$\alpha = \triangle\omega/\triangle t$$

These quantities are obtained as follows: Take the mechanism in positions slightly ahead of and slightly behind the desired position, each differing by an equal time difference, say 1/10 second or 1/25 second, or any convenient amount. Calculate A_v for each of the three positions A', A and A'', Fig. 3.

Then $\omega = A_v/(AC_v)$ for each position. When plotted against time as shown, the slope of the tangent at X is ω. yz is practically parallel to the tangent at X, so it may be substituted for it, and its slope is zw/yw, or $\triangle\omega\triangle t$. Any other system may be used to determine α, so long as a satisfactory approximation to the slope of the tangent at X is obtained. To recapitulate:

$$\triangle\omega = A_v'/A'C_v' - A_v''/A''C_v'', \triangle t = t' - t'', \alpha = \triangle\omega/\triangle t,$$
$$\text{and } A_t = \alpha \times (AC_v)$$

Now we know A_t and A_a with respect to C_v and A_a. Plot these values and find the resultant of A_t and A_n. The vector joining the tip of this resultant to the tip of A_a is d, the absolute acceleration of C_v. All parts of the body have the acceleration d, plus their radial and tangential accelerations which vary with their distance from C_v. For point B,

$$B_t = \alpha \times (BC_v)$$
$$B_n = \omega \times (BC_v) = A_n \times BC_v/AC_v$$
$$d = d$$
$$B_a = B_t + B_n + d \text{ vectorially}$$

All these may be calculated graphically as for fixed pivot parts.

Flying members shall be considered as being accelerated by a single force C_f, acting at the center of gravity of the piece C, Fig. 4. The acceleration of C may be determined from that of A just as B_a was determined.

$$C_t = \alpha \times (CC_v)$$
$$C_n = \omega \times (CC_v) = A_n \times CC_v/AC_v$$
$$d = d$$
$$\text{and } C_a = C_t + C_n + d \text{ vectorially}$$

C_a gives the magnitude and direction of the acceleration of the center of gravity. As $F = Ma$, $C_f = (w/g) \times C_a$ will give the force which, directed through C parallel to C_a, will produce the same acceleration in ACB that A_a and B_a indicate.

Determines Velocities Consecutively

In determining the velocities and accelerations throughout the train, start at the driving mechanism and run through piece by piece to the final piece, determining the velocities of the connecting points.[1] Go back and run through again, determining accelerations point by point. the velocity and acceleration of the A point of any piece are identical in magnitude and direction to those of the B point of the previous piece. For the last piece in the train, the space-time curve of the cam or crank, or whatever the driving mechanism is, gives the velocity and accel-

[1]Here "connecting points" applies only to those points which do not slide in either member, as for example sliding block linkages and cam surfaces within the train. Should sliding occur, the velocities and accelerations will not be the same in the two pieces at the point, and suitable correction factors should be introduced. It is possible that the components in the direction of sliding will be all that are desired, and these can be found easily.

eration of the *A* point. Thus equipped, we are ready to determine the interpart forces.

We will commence at the other end of the train (the tool end) and work backward toward the driving mechanisms determining the interpart forces as we go. It is assumed that the work force necessary to execute the function of the train of parts is known. Frictional forces may be calculated by the usual methods as soon as we know the forces acting at the connecting points and pivots. The force necessary to overcome the friction at any point will revert to the next connecting point toward the driving mechanism and will be accounted for there in this series of calculations.

Two Classes Employed

As before, we will be able to divide the analysis of the forces into two classes; one for fixed pivot parts and one for flying parts. At any connecting point where two members come together we can apply Newton's theorem that for every action there is an equal and opposite reaction. The force on point *A* of one piece will be equal and opposite to the force on point *B* of the adjacent piece.

Considering first the fixed pivot parts: The force on the *B* point may be in any direction, but only the tangential component will be transmitted through the train. The normal or radial component will be transmitted directly to the frame through the pivot. Note is to be taken of this force in designing the pivot, in calculating the friction loss at this point, and in calculating the overturning effects of the dynamic train upon the static base. We will call the

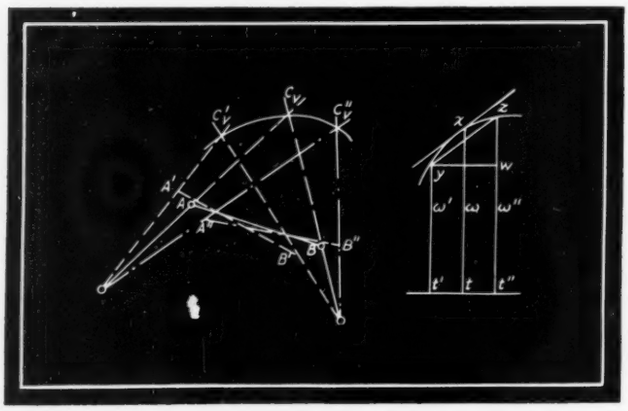


Fig. 3—Calculations are made with mechanism slightly ahead and behind desired position

tangential force at *B* which is a resisting force inasmuch as it brings a load onto the member B_{ft}, and the moment $OB \times B_{ft}$ the resisting moment. Note the direction of the moment (right hand or left hand). Then calculate the frictional moment or estimate its magnitude. It probably will be quite small with respect to the other moments and may be omitted if desired. Its direction will be opposite to the direction of rotation of the part, that is, it resists its rotation. Then calculate the accelerating moment $T=I\alpha$. This will be in direction opposite to the direction of acceleration of the part, representing a resistance to acceleration.

Moments Are Summed Up

Now sum up all the right-hand moments and all the left-hand moments and take the difference. This resultant moment must be balanced by the moment of the tangential force at *A*, A_{ft}. In equation form this is

$$B_{ft} \times BO + Friction + I\alpha - A_{ft} \times AO = 0$$

$$or\ A_{ft} = (B_{ft} \times BO + Friction + I\alpha) \div AO$$

The radial forces at *A* and *B* are determined by the reaction of the adjacent members, and are

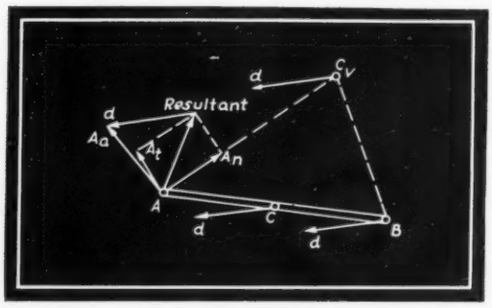


Fig. 4—Flying members are considered as being accelerated by a single force

transmitted direct to the framework of the machine. Fig. 5 represents a member such as a fixed pivot member.

Consider next the forces acting on the flying parts. We know the magnitude and direction of the inertia force acting through the center of gravity. The effect of the inertia of the piece is to retard acceleration so that the inertia force *I* is in the opposite direction to the acceleration C_a and force C_f, but is equal to the force C_f necessary to produce this acceleration. We may or may not know the entire force acting on the *B* end and we know nothing of the force acting at the *A* end.

Alternate Parts Are Fixed

A little reflection will show that almost invariably in a train of parts every other part is a fixed pivot part (or a sliding part) for which a complete force analysis may be made as above insofar as the tangential forces are concerned. The flying parts which we are now considering form the links between these fixed pivot parts. Fig. 6 shows such a flying part joining two cranks to form a four bar linkage. The known

forces are labelled, and the four unknown components a, c, i and k are indicated. A set of axes is assumed through A as the origin. Let us call these X and Y. k and i are taken along X and Y for convenience, and a and c are also along and parallel to X and Y. a and c are related, as

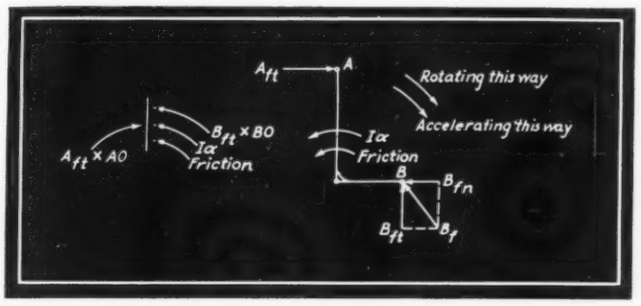


Fig. 5—Radial forces are transmitted directly to the framework of the machine being studied

they must be components of the normal force at B of the right-hand crank; b represents this force (B_{fn}). Now as the piece ACB is a rigid body acted on by a series of forces, these forces must be in equilibrium or we would not get the acceleration we had counted on. The conditions for equilibrium are three:

$$\Sigma M = 0, \Sigma X = 0, \text{and } \Sigma Y = 0$$

We have three unknowns, components k, i and a (or c). Therefore we may proceed to solve. Take the sum of the moments about point A. We have

$$g \times AC + f \times AB + a \times AB = 0$$

This gives us force a. By completing the parallelogram we get force b, which is B_{fn}, and

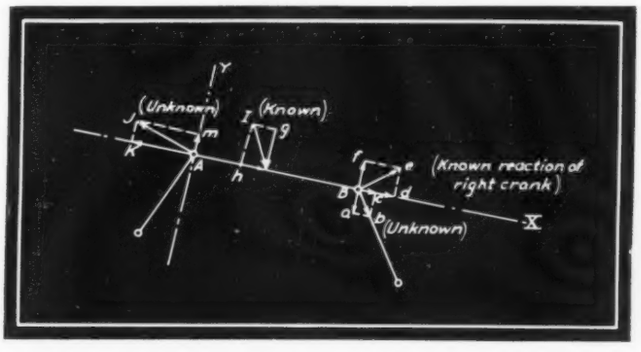


Fig. 6—Flying parts, such as this one joining two cranks, form links between fixed pivot parts

force c. Then taking $\Sigma X = 0$, we have

$$c + d + h + k = 0$$

giving us force k, and taking $\Sigma Y = 0$, we have

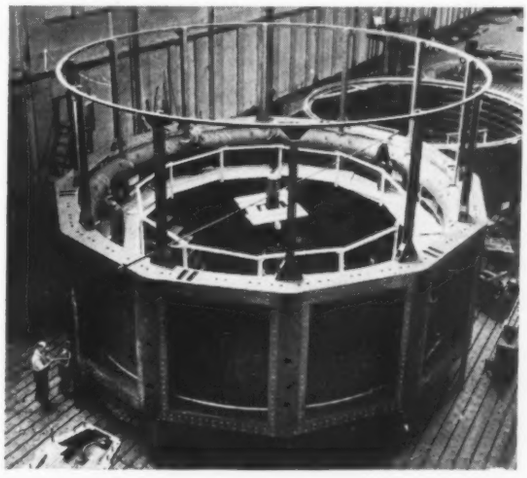
$$a + f + g + i = 0$$

giving us force i. Note that proper signs must be affixed to the forces. We can now combine k and i graphically and we will have j, which is A_f, the force at A. If we combine b and e we will get B_f, the force at B. When prolonged, these lines A_f and B_f should intersect on the line of action of the inertia force I, thus giving us a check on our work. All of the above work can be done graphically with the exception of the calculation of ΣM_a. The check is purely graphic.

The solution of these problems by the employment of nomograph charts will be developed fully in the last article of this series in the January MACHINE DESIGN.

Valves Utilize Special Welding Rod

MORE than four million pounds of steel and special materials were required in the production of the world's largest valves for Boulder Dam, and to ship them to the dam site will require about ninety railroad cars. Standard steel plate rolled, cut to size and welded, with a



Careful construction enabled a perfect seal on this giant valve

special heavy coated welding rod developed for this job, form the 32-foot cylindrical gates and nose liners. There were 28,200 inches of weld employing 252 positions of the sub and main assemblies needed to complete the welding on the nose liner alone, the largest stationary part of the gate.

Due to the care with which the mammoth gates were fabricated, every piece fitted into place with precision and a water-tight seal was secured in the test assembly at the Westinghouse shops. The monel metal seats, employing 110,000 pounds of this material, making the water-tight seal between the gate valve and the throat and nose liners were carefully machined to assure accuracy. Adjusting screws are provided for obtaining a perfect seal and locking into position on the upper seat only of each gate.

Progress in Stainless Steels

Air Conditioning also Is Covered in New Technical Volumes

Book of Stainless Steels

Edited by Ernest E. Thum; published by the American Society for Steel Treating, Cleveland; available through MACHINE DESIGN *for $5.00 plus 15 cents postage.*

Appearance of this new volume is hailed as a most important addition to existing technical literature. Previously no book describing American usage and practice in this class of materials had been printed. Seventy-seven authorities on making and using many types of heat and corrosion resisting chromium alloys collaborated in writing this 614-page book. Each author was selected to provide a chapter on his particular specialty in the industry.

Needless to say, the text is authoritative. Because it is a logical and consecutive compendium of practical information emphasizing the uses of various grades of stainless steel, designers should not overlook it. The data on how they are fabricated and what to expect of them may save engineers difficulties that otherwise might prove costly. A multitude of applications are described by men in the consuming industries who know these applications intimately.

The ever-widening field for stainless indicates that this compilation will be of value to engineers in many industries, from the manufacture of artificial silks to the building of heavy machinery. So clearly and completely is the information presented that the reader need not be a highly trained metallurgist to profit from it; however, the most demanding technician will find the information precise.

□ □ □

Mechanical Engineers' Handbook

Lionel S. Marks, editor-in-chief; published by McGraw-Hill Book Co., New York; available through MACHINE DESIGN *for $7.00 plus 15 cents postage.*

Completely revised, the third edition of this well-known handbook contains nearly 300 pages more of pertinent technical data than the previous issue. Mr. Marks, professor of mechanical engineering, Harvard university, was assisted by a staff of 75 specialists in its preparation. This alone connotes its scope.

New sections of particular interest to designers of machinery, have been added. Its contents are indicative of the rapid progress along all engineering fronts. Theoretical discussions have been strengthened to supply the mechanical engineer with theory and data demanded by constantly increasing limits in size, pressures, temperatures, speeds and other governing factors.

□ □ □

Air Conditioning

By James A. Moyer and Raymond U. Fittz; published by McGraw-Hill Book Co., New York; available through MACHINE DESIGN *for $4.00 plus 15 cents postage.*

One of the newer fields in which engineers are concentrating a great deal of effort is air conditioning; therefore it is logical that a book should appear covering important fundamentals in this phase of development. Treatment is complete and practical. Information is provided for the man engaged in design of air conditioning equipment, as well as for those interested in its selection and operation for various applications. The designer necessarily must be familiar with all aspects, and consequently the volume will have a particular appeal to him.

First half of the book is devoted to theoretical fundamentals and discusses various phases of air conditioning. The second part gives a thorough study of design requirements and typical layouts for numerous different uses. Included in the text are examples of characteristic air conditioning designs with the necessary calculations for theaters, office buildings, food factories, textile mills and homes. A relatively complete discussion is given of reversed refrigeration which embodies the heat-pump system, as used for heating of buildings.

Particular attention is directed to recent advances in household, office building, railroad train and theater applications.

By C. F. Nystrom

and

R. H. Tull

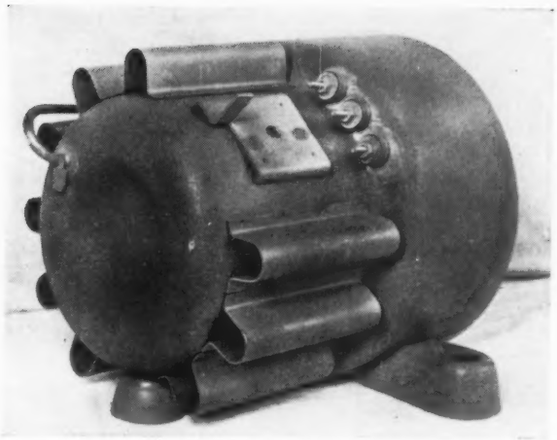


Fig. 1—Compressors must be designed to meet the special problems involved in refrigerator applications

How Service Conditions Are Met in Refrigerator Design

ALTHOUGH mechanical details of the refrigerating unit are given slight consideration by purchasers of domestic refrigerators, it is attention to these details which builds safety, quietness and satisfactory overall performance into the finished unit. Correct mechanical design is particularly important when it is considered that no other household appliance is called upon to perform under the service conditions which the electric refrigerator encounters. It must give dependable, troublefree service twenty-four hours a day, year after year, winter and summer, under widely varying temperature and load conditions without adjustment or attention.

In the development of compressors, the major element of a refrigerating unit, the primary objectives have been simplicity of design, improved performance, low manufacturing cost, and long life with a minimum possibility of trouble in service. The progress made is shown by the fact that the present Westinghouse compressor has a total of 125 parts, weighs but 55 pounds and has only 8 wearing surfaces, as compared with the first design which had 195 parts, weighed 115 pounds and had 16 wearing surfaces.

WHEN a mechanism must operate quietly, safely and surely without checking, great responsibility rests on the designers. These are the conditions which the compressor, the heart of the electric refrigeration unit, must satisfy. The authors, refrigeration engineering department, East Springfield works, Westinghouse Electric & Mfg. Co., tell of designing for such service.

The compressor is an ordinary pump except that it must be designed to meet the special problems involved in a refrigerator application. For instance, the pump must operate efficiently over a wide range of suction and discharge pressures. Suction pressure is determined by the evaporator temperature and refrigerator load. Discharge pressure is governed by the temperature of the condenser, always slightly above room temperature. Minimum operating pressures are encountered in a cool room. Using sulphur dioxide refrigerant and operating in a 65 degree Fahr. room, the minimum suction pressure is about 20 inches mercury vacuum, and the discharge pressure about 35 pounds per square inch gage. In a 110 degree Fahr. room the maximum operating suction pressure is about 10 pounds per square inch gage, and the maximum discharge pressure about 150. The extremes of operating conditions represent a variation in load of over 600 per cent.

If the unit is started after standing for some time in a 110 degree Fahr. room, the suc-

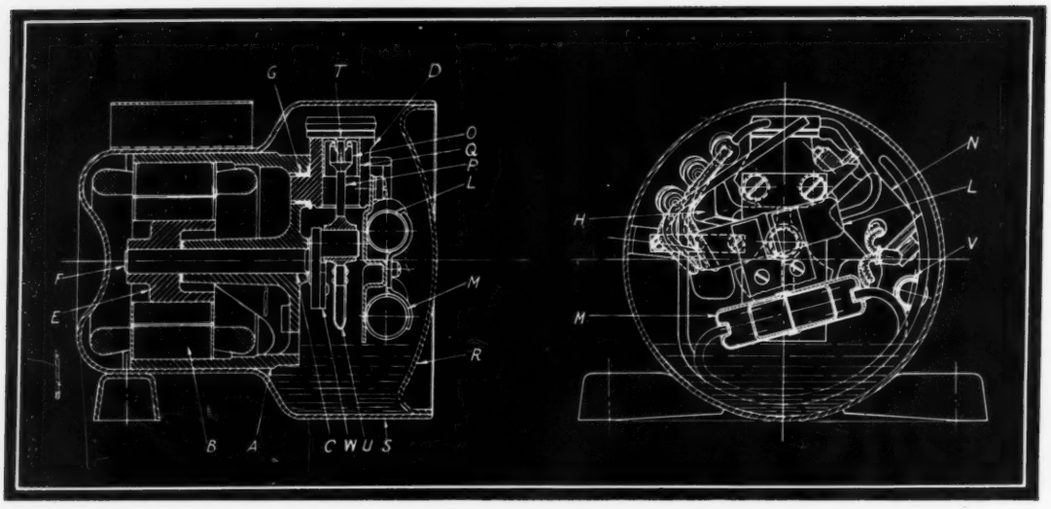


Fig. 2—A split phase induction motor is directly connected to the crankshaft

tion pressure at the start will be about 85 pounds per square inch. Shortly after the unit starts, during the so-called "pull down" period, the discharge pressure may rise to 225 to 250 for a short period of time. The driving motor and the compressor shaft and bearings must be designed to stand this high peak load during pull down.

On account of the low suction pressure reached in a cold room the compressor must be designed to give high volumetric efficiency. This means small head clearances and careful designing of valves and valve ports. Domestic refrigerator compressors usually have an extremely small head clearance, sometimes as low as 0.002 inch. However, if the head clearance is kept too small the unit is apt to be noisy and liquid refrigerant or oil drawn into the compressor may cause rupture of the cylinder. When the refrigerant vapor is compressed it becomes superheated. This causes high cylinder head temperatures with the attendant problems of heat dissipation, lubrication, and expansion of the cylinder and piston. These are some of the complex problems involved in the design of a compressor.

Compressor Is Described

A brief description of the compressor will aid in demonstrating how these problems have been solved. The improved compressor, Fig. 1, has a single vertical cylinder with a reciprocating piston having a one-inch bore and ⅞-inch stroke. It is driven by a ⅛ horsepower, 4-pole, 1740 revolutions per minute, split phase induction motor directly connected to the crankshaft as shown in Fig. 2. The complete motor compressor assembly is built up on the motor frame casting *A*, Fig. 2. The same parts designations are used in Fig. 4. The motor stator, *B*, is pressed into this casting, the center portion of which forms the main bearing, *C*, while the closed end serves as a mounting bracket for the compressor cylinder, *D*. The motor rotor, *E*, is pressed on the crankshaft, *F*, at the end opposite the crank pin. The single main bearing is thus between the rotor fit and the crank pin shoulder. End clearance of the shaft is held by carefully gaging the distance the rotor is pressed on the crankshaft.

The motor frame is of high grade cast iron, while the crankshaft is a drop forging from nitralloy steel. It is nitrided, before final grinding to size, to give a brinell hardness of about 800. The piston is an automatic screw machine product turned from bar tool steel, heat treated and ground to final size. The connecting rod is forged from a vanadium steel alloy and heat treated and ground to size. Nitralloy steel, nitrided to a brinell hardness of about 1000 and ground to size is used for the wrist pin, while the cylinder is of a high grade cast iron with the bore honed to size. All revolving and reciprocating parts are carefully balanced to minimize vibration.

It is a well known fact that a nonuniform air gap between the rotor and stator will unbalance the magnetic field. This causes noise and an uneven starting torque. Poorly aligned bearings aggravate this trouble. By adoptitng the design described, a perfect alignment between the motor and compressor cylinder is obtained as well as a uniform air gap between rotor and stator.

This construction has still another advantage. With this design the complete compressor assembly can be run for test, and to work in the bearings, before it is sealed into the compressor shell. In this way any machines which do not pass a rigid inspection can be rebuilt at little expense. Each compressor assembly at this stage of its manufacture is given a six-hour run to wear in the bearings and a starting and pump test before it is pressed into the steel shell.

For each hour of continuous operation the compressor makes many thousands of revolutions, each valve being flexed every revolution. At each revolution hot exhaust gas at compara-

tively high speed and pressure is forced past the valve at the discharge port. Under ordinary operating conditions, the exhaust valve temperature is approximately 300 degrees Fahr., but under abnormal conditions it may rise to over 450 degrees Fahr.

To stand up under these conditions a low inertia valve is essential. The material for these valves must have high tensile strength, together with ability to withstand millions of repetitions of stress, as well as good corrosive resistance at elevated temperatures. As the valve operates under tension and impact, sufficient strength at high temperature is required to prevent breakage and distortion. To meet all these conditions a material known as "Ultra Superior Bright Swedish Flapper Valve Steel" was selected after exhaustive tests.

Mufflers Are Employed

Surging of gas through the suction and discharge ports sets up sound impulses which must be absorbed for quiet operation. The suction and discharge mufflers, similar in construction, perform this function. Mufflers are made from a set of drawn brass cups nested together and silver soldered as shown at the right in Fig. 2; small holes in the bottom of these cups act as baffles for the gas and break up the impulses. Mufflers are silver soldered in the suction and discharge tubes and then connected to the cylinder head as shown. The intake of the suction tube is located near the top of the compressor shell and is faced away from the oil spray so that as little oil as possible is drawn into it.

In the assembly of the compressor the correct piston wall clearance has been found from tests to be 0.0006 to 0.0008-inch on the diameter. In order to hold this limit of 0.0002 inch and still not set up impractical tolerances in manufacture, a selective assembly is used with these parts. The pistons and cylinders are segregated according to size at inspection and the corresponding sizes matched in assembly to give the piston wall clearance specified.

Since no gaskets are used to seal the valve plate and cylinder head, some scheme for ob-

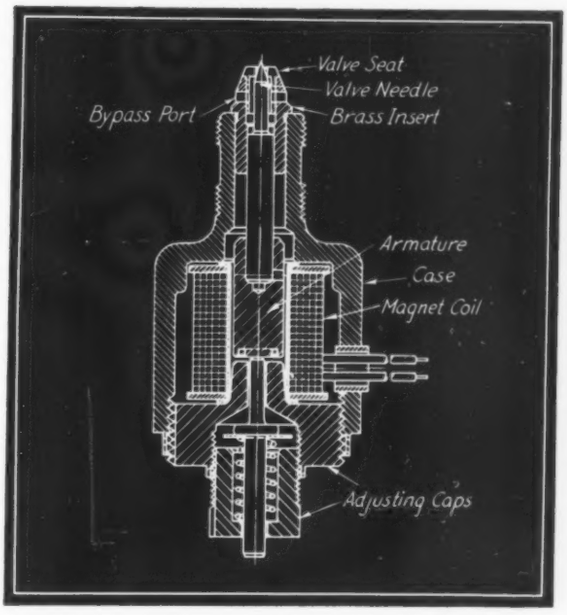


Fig. 3—Specially designed solenoid valve is employed as an unloader mechanism

taining uniform head clearance is necessary to allow for manufacturing variations. This adjustment is accomplished by the use of an eccentric bushing which fits into the motor frame casting as shown at *G* in Fig. 2. A circular projection which is cast integrally with the cylinder projects into this bushing. By rotating this bushing the cylinder can be raised or lowered. The desired cylinder head clearance is simply measured by a depth gage from the top of the cylinder. When the cylinder is properly located it is securely clamped in place by the cylinder clamping bolts, while the bushing is staked in place by forc-

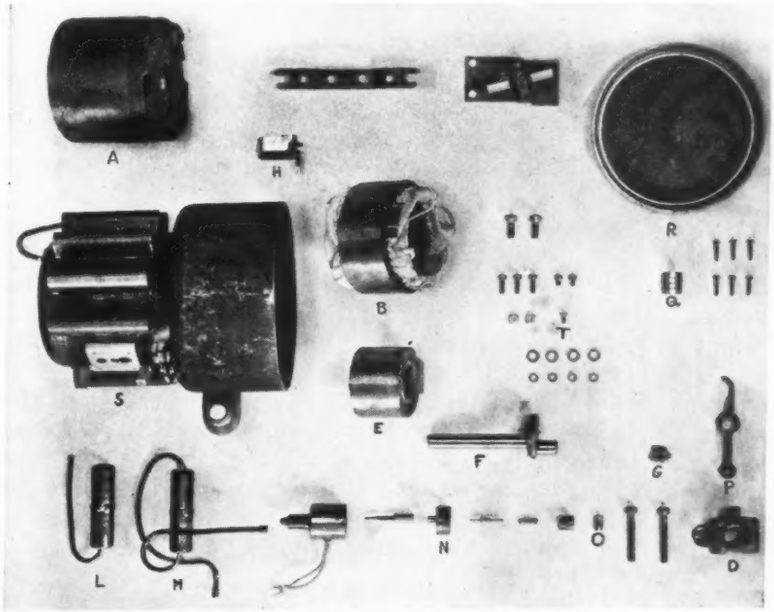


Fig. 4—Compressor parts include: A, motor frame casting; B, motor stator; C, motor bearing; D, cylinder body; E, motor rotor; F, crankshaft; G, eccentric bushing; H, oil catcher; L, suction muffler; M, discharge muffler; N, unloader; O, wrist pin; P, connecting rod; Q, piston; R, end head; S, shell; T, wrist pin screw; U, oil scoop; V, suction line strainer; and W, counterbalance. Same designations used in Fig. 2

ing one of the fingers around its edge into a groove in the housing. From the standpoint of economical production this design has a great advantage in that it permits greater tolerances on the parts. From an operating standpoint also this design is of importance, since it enables the maintenance of more uniform head clearances which in turn helps to maintain more constant volumetric efficiency.

Must Consider Lubrication

Lubrication of the compressor and the speed at which it operates must be considered because the permissible bearing pressures increase with the surface speed. The reason for this is that the higher the surface speed the more effective-

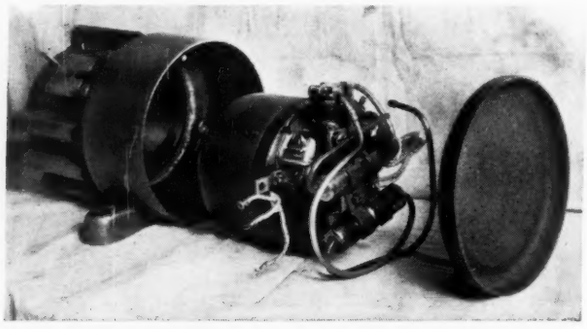


Fig. 5—Exploded view of the compressor showing shell, compressor-motor assembly and end head

ly the lubricant is dragged into the bearing against the hydraulic pressure due to the load carried. The high speed bearing acts as a pump for its lubricant. By increasing the motor speed from 1140 revolutions per minute, the speed of the original design to 1740 revolutions per minute, the speed of the present compressor, the projected bearing areas were reduced and the over all compressor efficiency was materially increased.

Oil Bath Employed

Experiments have shown that an oil bath is much superior to any other method of lubrication for this service. The bath of oil is obtained by the use of an oil scoop, riveted to a projection of the connecting rod which directs a stream of oil into an oil catcher located above and to the left of the main bearing, *H*, in Fig. 2. From the oil catcher the oil flows in a steady stream on to the main bearing where it is distributed by a groove in the top of the bearing. The wrist pin, connecting rod, and cylinder wall surfaces are bathed in the copious splash of oil thrown up by the oil scoop.

Included as part of the compressor assembly is the electro-pneumatic unloader valve shown in section in Fig. 3. This is a specially designed solenoid valve which opens a by-pass port with the first rush of starting current and thus unloads the compressor during the starting period. It also acts as a high pressure relief valve to protect the system from excessive pressures. Cost of construction has been kept low by making the valve mechanism from automatic screw machine products, the valve seat being turned from drill rod. The needle is made from nitralloy steel nitrided and ground to size, and the valve seat is pressed into a brass insert which breaks up the magnetic path and keeps the needle from being held to the seat. Adjustments in operating current and blow-off pressure are made with the threaded caps. After adjustment the caps are staked in place and the unloader is screwed into the cylinder casting as is illustrated in Fig. 2.

Fins Are Welded to Shell

The complete compressor motor assembly, after passing the required tests and inspection, is pressed into the drawn steel compressor shell. Heat dissipating fins are welded to the outside of this shell to increase the external surface as one of the most troublesome problems in compressor design is that of heat dissipation. All of the heat due to the motor losses and much of the heat from the compressed vapor must be dissipated from the compressor shell. With this design, all of the heat is generated in parts which are in direct contact with the motor frame casting. Since this casting is pressed into the steel shell and thus becomes an integral part of it, a continuous metallic path is provided for the flow of heat out to the dissipating surface. A small fan, used in the complete unit to circulate the cooling air over the condenser, aids in the efficient removal of the heat from the shell and fins.

Seals Are Important

The discharge pipe from the compressor is carried directly through the shell to the condenser through a silver soldered joint at the compressor shell. The suction pipe from the evaporator is silver soldered into a strainer inside the shell. Electrical connections to the motor are brought through the shell by a simple, yet effective sealing terminal. After these connections have been brought out through the shell the compressor is hermetically sealed inside of it. The word "hermetic seal" has been much misused. In a refrigerator the life of the unit is dependent on how well sealing is accomplished. The compressor under discussion is

(Concluded on Page 50)

Organizing Design Procedure

By H. W . Hoover

A DISCUSSION of the development processes that precede the introduction of a new model is apt to become somewhat involved due to the number of points that must be considered and the relationships that exist between co-operating departments. The accompanying chart shows the progress of an assignment through the development stages to actual delivery of salable articles.

The first tangible step is a management decision that such action should be taken, Item 1. Step two is the transmission of the management's assignment to the engineering department. In most cases this is in the nature of a general request that a new model be developed. At this time the management should outline its general requirements and give the required specific instructions.

With this authorization we come to step three, the specific interpretation of the assignment by the engineering executives and the formulation of a program. Each of these steps may entail extended investigations in order that the fourth step, which may be termed "experimental development," can be launched on a sound basis. At this stage it is necessary to gather the data that will be used in the design of the new machines.

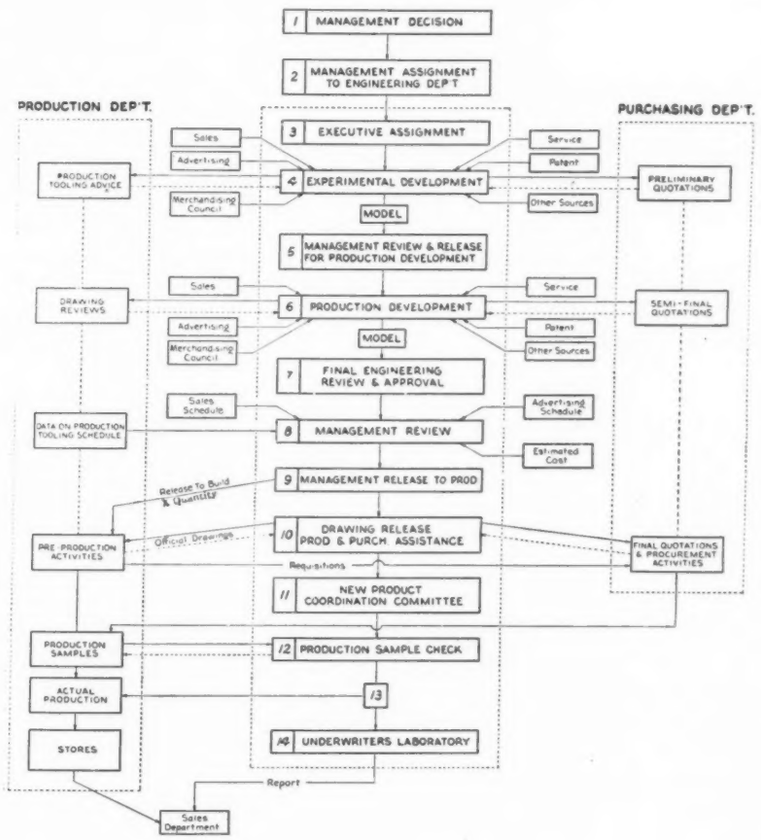
Work Is Reviewed

At the completion of this activity it is advisable that the work of the engineering department be reviewed by the management, so item five appears on the chart in the nature of a management review of experimental models. Performance characteristics, tentative cost estimates, etc., should be presented for consideration. An expression of management opinion as to adequacy of the development to date is essential.

Assuming that the experimental models fulfill the requirements and the engineering department is instructed to proceed with the production development (see item six), this department then undertakes to resolve the experimental design into final production shape. This requires close co-operation with the production and purchasing departments so that they may eliminate, so far as possible, the differing viewpoints with respect to employment of production processes, materials, design features, etc.

To this end the production department is called in to review and approve the various component parts and their associated production problems. The purchasing department is requested to secure semifinal quotations when certain pieces are to be secured from external suppliers. The suggestions of these suppliers with respect to minor design changes to facilitate production are incorporated whenever this is possible.

When the engineering department has fulfilled to a reasonable extent the requirements of various associated departments, a group of tentative production models is built and tested; the design is submitted to the service department for the final review; and a production release is requested from the patent department to make certain the design has been approved. Models



are then submitted to the sales department for its criticism, to secure at once opinions from a group of individuals not associated with the devevelopment.

Changes are incorporated in accordance with the validity of suggestions received. Final styling conferences are held with representatives of the sales and advertising departments and such merchandising counsel as is considered necessary. All of this activity is covered by item six on the chart. After its completion we reach item seven, which is the final review and approval of the engineering department.

The next step in the development is the submission of the model to the management as covered by item eight and at this time various other departments are called upon to contribute information that will asist in the formulation of decisions. Typical items may be: Performance data; estimated cost data; plans from advertising department; tentative sales department schedules and merchandising plans; and the tooling program data.

RECENT years have drawn attention more pointedly to the need for better methods in many lines of business activity. Engineering departments, with their research, design and general service functions, are no exception. Mr. Hoover, president, The Hoover Co., presents in this article, abstracted from a recent issue of "Executives Service Bulletin," a practical method of co-ordinating all engineering activities.

It is not always possible to carry on activities of items six, seven and eight in the sequence described as the subject matter overlaps to a great extent and the activities react upon each other.

The next step is the management decision to proceed with the usual production routine, No. 9. In case this decision is reached, instructions are issued approving release to production and governing subsequent activities.

Center of Activity Shifts

At this point the center of activity shifts to the production department as shown by the solid lines now appearing between blocks in the left-hand column on the chart. The corresponding engineering item, ten, indicates release of production drawings and the rendering of assistance to the production, purchasing and inspection departments during the production tooling period. During this interval the production department also issues requisitions for stock and the purchasing department secures its final quotations, etc.

During the production tooling period there is need for a review of the company activities to see that all branches are correlated and prepared for the advent of the new production model, item 11. This duty falls upon the new products co-ordination committee, composed of representatives from the various major departments. This committee holds meetings as necessary to check and expedite all associated activities.

With the completion of the tooling program the production department undertakes the production sample activity, item 12 on the chart. This usually involves a quantity of about 100 machines and is carried on for a dual purpose: The proving of production tooling and provision of a chance to review and rework portions thereof, should it be necessary before starting production, and providing production samples for engineering examination and test. This work results in the establishment of final performance specifications which usually differ in some degree from averages of handmade experimental models. Generally a period of about one month is allowed for this activity, thus affording time for the execution of such minor changes in design and tooling set-up as the various departments may make.

Item 13 covers actual production activity. This next step is not a part of the engineering program except in so far as it is necessary to render assistance in connection with various production and purchasing questions as they arise. When actual production machines have been delivered to stores, samples are drawn for submission to the Underwriters' Laboratories and the Hydro Commission of Ontario in accordance with item 14. Their regulations make it impossible to secure the listing of the new models by these organizations until actual production machines are available for test and examination. It is standard practice, however, to seek their assistance during the experimental and production development periods. In many cases unofficial handmade samples are submitted for consideration in order that their recommendations may be obtained.

Upon receipt of reports listing the new production as "standard," suitable information is sent to the sales and advertising department.

The success obtained by an engineering department in an undertaking such as the one outlined is predicted by its appreciation of the benefits to be derived from the information gathered from associated sources. The establishment and maintenance of harmonious relations with the various company departments capable of supplying this information, and correct interpretation of data are looked upon as responsibilities of the engineering department.

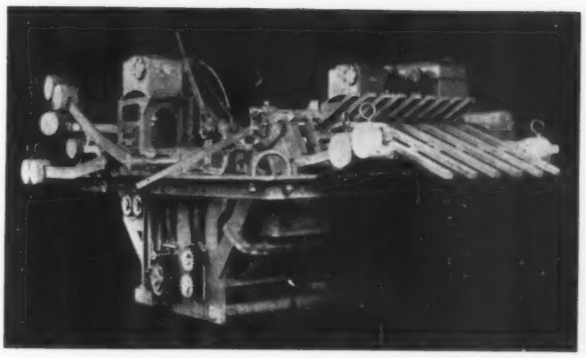


Fig. 1—Speed in relation to wear of galvanizing rolls can be adjusted by the variable speed transmission

Precise Speed Control Improves Production

By Allen F. Clark
Associate Editor, Machine Design

ONE of the most important problems in the development of production machinery is that of making the machine thoroughly flexible in speed control. This means that the machine must be equipped to perform efficiently under every different operating condition it may encounter. After the machine is built, the time of the operations is the only factor possible of control by the operator—and time is the most important element in any machine operation today.

Certain machines must necessarily handle a wide range of sizes, shapes and weights of the product they process. Others must be able to compensate, to some extent, for varying climatic conditions and different degrees of temperature and humidity. Some are designed to run synchronously with others, such as the cylinders of a rotary press and the cylinders of a waxing machine, synchronized to insure proper tension of the sheet between the machines. Further, there may be the necessity for a change in "tempo" in accordance with the speed of the workman—comparatively slow at 8 a.m., at maximum speed at 11, and slower again in the late afternoon.

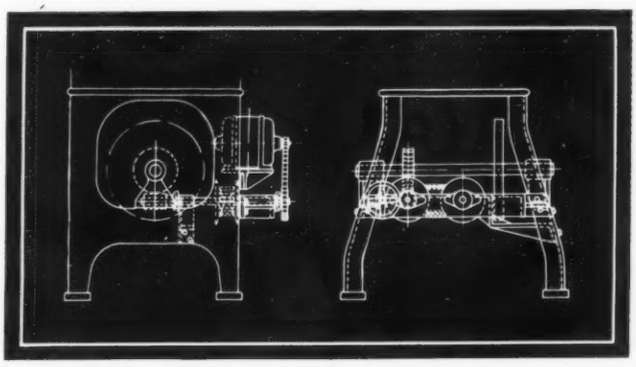


Fig. 2—Units may be built compactly into the machine to be driven and regulated

Small Variations Desirable

Cone or step pulleys and selective gear boxes are forms of speed control which provide a fixed number of speeds. A belt pulley, a gear or a chain wheel may be changed, but such changes require the stopping of the machine. In this article applications of mechanical variable speed transmissions, by which infinitely small variations in the speed of the driven machine can be secured without stopping the machine, will be considered. Hydraulic transmissions, electric controllers and variable speed motors will be discussed in future issues of MACHINE DESIGN.

The majority of mechanical variable speed transmissions now in use utilize in their design the principle of varying pulley diameters, a variation secured by adjusting the spacing between two conical disks. Motor pulleys, Figs. 5 and 9, are adaptions of this principle designed especially for installations of limited speed range and horsepower. One disk of the pulley is stationary while one slides laterally on the motor shaft. A clockwise turn of a handwheel moves the sliding base away from the driven machine, and as the sliding disk moves out on its shaft the V-belt assumes smaller diameter on the motor shaft, re-

ducing the speed of the machine being driven.

The simplest of the members connecting the two disks on the conventional units is in the form of a standard V-belt, although this belt is wider than the standard designs. A popular form of connecting member, shown clearly in Figs. 8 and 11, has a base of rubber cord belting. Two rows of hardwood blocks tipped with leather, one row above and one below the belt body are clamped together to complete the member. Another efficient method of transferring

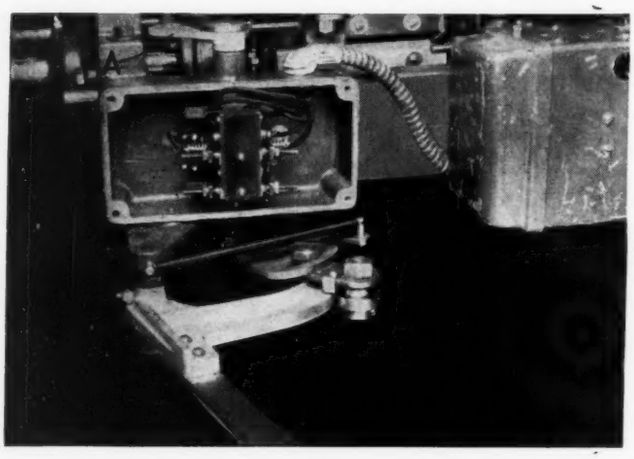


Fig. 3—Desired sequence of speeds is provided by transmissions under cam control

the power utilizes a chain of unique design as the driving member to give a positive drive, Fig. 7. This chain is provided with flexible teeth projecting from both sides, the teeth engaging in radial teeth which are cut in the disks in this type of drive.

Overrunning Clutches Used

Numerous other transmissions for securing an infinite variation of speed have been devised. A recent development, Fig. 4, is a mechanical means of speed control which eliminates the possible necessity for an additional speed reducer. The unit is composed of five one-way overrunning clutches, the five clutches transmitting power in uniform cycles to a centrally mounted driven gear. Speed changes are accomplished by changing the stroke of the arms attached to the clutches. When the unit is driven by a 1200 R.P.M. motor, the output shaft receives 6000 pulsations per minute.

Another transmission makes use of a nutating element, variation of the angle of which from the vertical varies the output speed. Conical rollers arranged in a planetary manner operating against fixed and movable conical rings are employed in another design.

The location and position of the various speed transmissions in the machine to be driven and the control of the transmissions are as completely variable as the speed of the machines the units drive. Control may be manual and remote or electric and remote. Automatic control is particularly valuable when the speed of two machines must be synchronized. This control may be secured through levers, switches or photoelectric cells, or a cam control may be designed for a desired speed curve. The transmission in Fig. 6 is equipped to provide accurate time cycle control. This control is so fine that the control shaft actually operates at ½ thousandth turns per minute.

Cam Gives Precise Control

Cam control as applied to a variable speed transmission driving a winding unit at the end of a printing machine permits the complete utilization of the possibilities of the transmission. A cam, *A* in Fig. 3, is finished to a shape to give an exact uniform speed change. The operation of the machine is entirely automatic as the transmission controlled by this cam gradually decreases the speed of the roll shaft as the diameter of the paper on the roll increases. At the end of the operation, that is when the roll is full size, the machine is stopped and the roll removed. At this point in the operation the control automaticaly changes the speed of the transmission and the spindle which drives the roll shaft, resetting the transmission so that it will operate at its fastest speed when the new roll core is placed in position. Thus a constant tension on the paper being rolled is maintained.

With such a wide range of possible combinations available, including transmissions which are combined with a motor in a single case or combined with a motor and an additional speed reducer to give a single compact drive unit, it rests with the designer, with the assistance of the manufacturers, to select the drive that will be the exact answer to his speed requirements. The operating parts alone, without the frame, or the transmission as a whole can be incorporated as a part of the machine to be driven, Fig. 8. Fig. 2, showing a transmission built into an automatic soda machine, illustrates better than any written description how this can be done. It should be remembered in building the transmission into the design that the parts of certain makes of units must operate in a bath of lubricant.

Varying Sizes Accommodated

As an interchange of ideas between industries is one of the greatest sources of design information, it might be well to study other representative applications and to determine how the use of a variable speed transmission benefited the

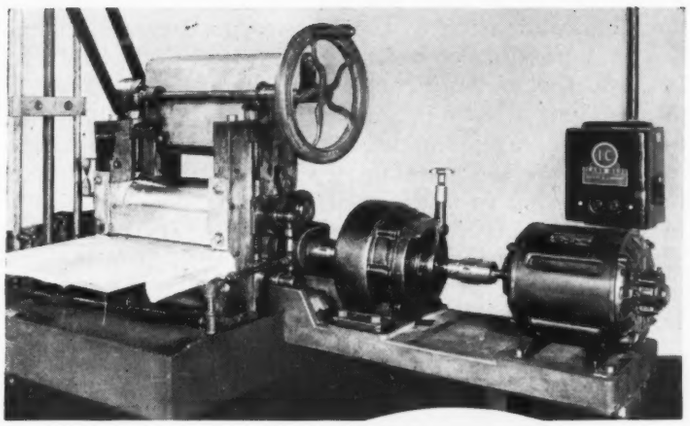
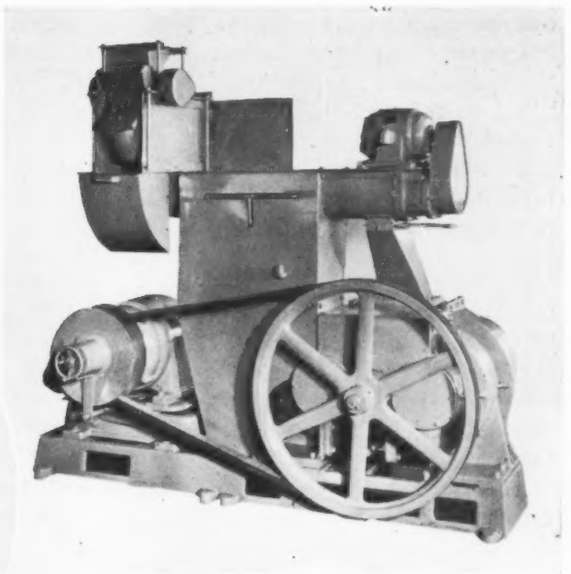


Fig. 4 (Left)—Unit operating through five one-way overrunning clutches adjusts speed to correspond with size of product

Fig. 5 (Below)—V-belts of standard dimensions, except for the width, are used as driving members in some makes



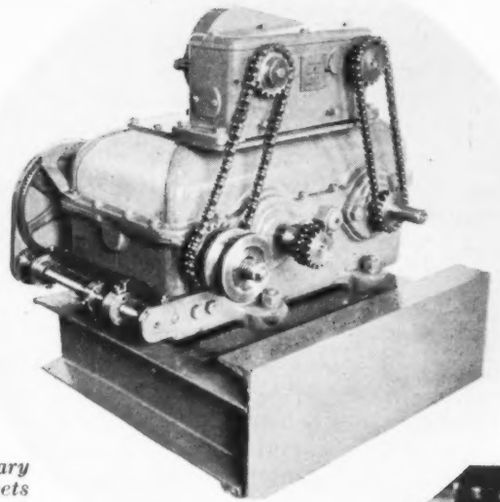


Fig. 6.—Auxiliary motors, gearsets and driving means will enable accurate time cycle control to the exact specifications of the designer

Fig. 7 (Left)—One form of drive member is a chain with teeth projecting from both sides

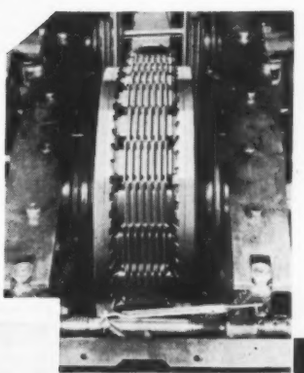
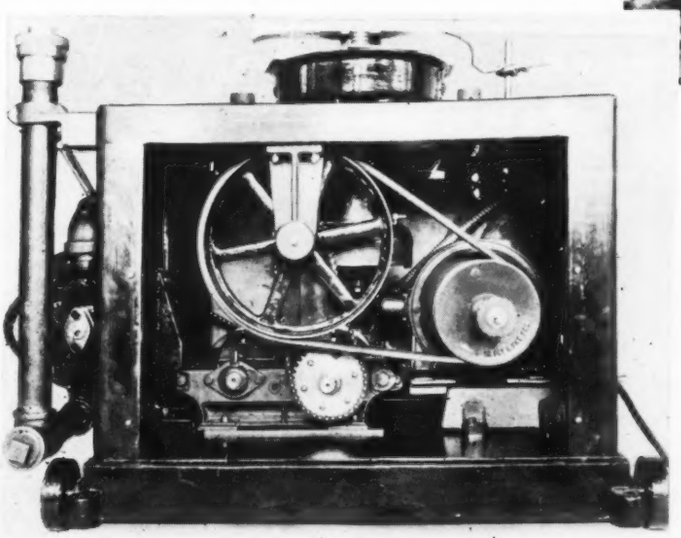


Fig. 8 (Below)—Rubber cord belting connecting member faced with two rows of hardwood blocks can be seen clearly in this application of a variable speed transmission



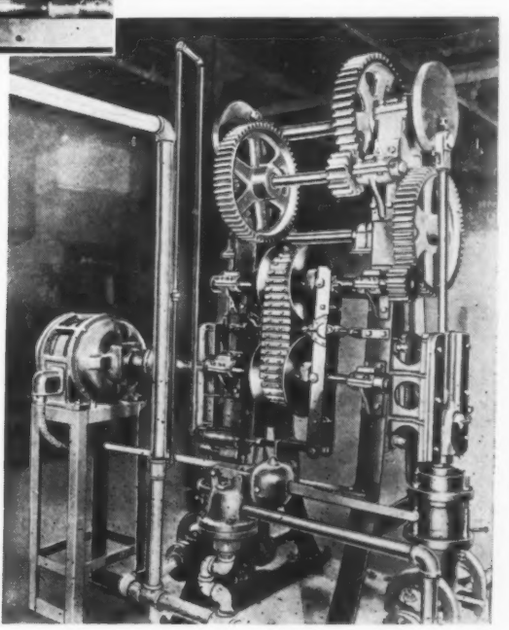


Fig. 9—Motor pulley units, right, are especially adaptable for installations of limited speed range and horsepower. They may be combined with a conventional unit such as the one shown at lower left to provide an exact control

design. The unit shown in Fig. 4 is applied to roll mills used in making fillets on which the type of fillets have to be run through the rolls at various speeds. It is important that the time of the operation be controlled to an exact degree. The speed at which these fillets run through the rolls is controlled manually by the operator on this machine. Wear in galvanizing rolls may seriously affect the performance of the machine, so the unit shown in Fig. 1 was applied to rolls of this type to justify speed in relation to roll wear.

A variable speed transmission was found to be an eminently satisfactory solution to the problem of speed control for a slip pump, used in the ceramic industry and illustrated in Fig. 8. This pump passes clay held in suspension into the filter press which runs at a constant speed. The automatically controlled transmission will speed up when the press is ready to be charged and will from then on, until the filter press cake is ready to be removed, automatically decrease the speed and pump just the amount of filtrate that is needed by the filter press to maintain the density of the mass.

Must Process Different Materials

Machine tool design is another fertile field for the application of these transmissions. A hobbing machine operating on steel, cast iron or brass must necessarily be adjustable as to time

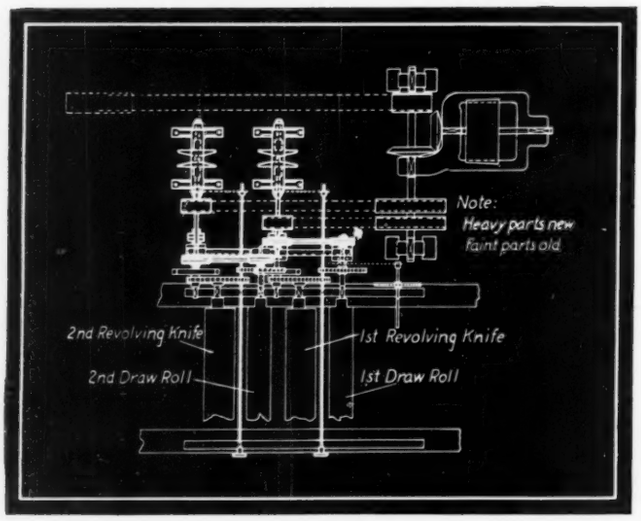


Fig. 10—Redesign to change shaft center distances radically reduces number of parts

of operation. No other factor besides time can be adjusted in the operation of the machine. On a milling machine different sizes of cutting tools require proper changes in speed in order to maintain a uniform peripheral cutting speed. On one machine now in use the cutting tools range from 2 to 12 inches in diameter. Through the application of a variable speed transmission it is possible to obtain a variation of from 30 to 150 feet cutting speed per minute.

Heat treatment of a wide variety of sizes can be accomplished in furnaces equipped so that the time the product remains in the furnace can be varied to suit the size of product being processed. Insufficient heat treatment, too much heat treatment, waste or considerable difficulty are liable to arise if the speed cannot be adjusted by minute intervals.

Maintains Proper Tension

Paper, cloth or yarn being treated by several different machines or mechanisms, passes through the processing machines in a continuous strip. Breakage or undue sag, can be avoided by adjusting the speed of the various machines so that the proper tension will be placed on the material at all times.

Simplified design can be accomplished even after the decision to employ a variable speed transmission has been made. For example, in the first model of the paper cutter manufactured by the Black-Clawson Co. two transmissions were used. These units received their power from belts extending through the floor to two pulleys. The pulleys, two cones (not part of the transmissions) and bevel gears, located on the variable speed lineshaft and on a countershaft which carried one of the cones, were all located in the basement while the transmissions were placed on the same level with the paper cutter.

In redesigning to change the center measurements and location of the shafts of the paper cutter, Fig. 11, to correspond to the location of the variable speed transmission shafts, all of the belt drives except one belt which drives to one of the constant speed shafts of the transmission were eliminated, Fig. 10. The saving of parts included two gears, two countershafts, two cone pulleys, eight pulleys and six belts.

Varies Speed of Knife

The object of the transmission in this case is to change the speed of the knife in relation to the speed of the paper in order to cut different lengths of sheets. With all the belts and pulleys included in the original design there was considerable variation in the sheet lengths due to belt slippage, etc. With the new design of cutter and driving arrangement, shown in Fig. 10, there is practically no variation in the length of sheets.

A number of speed control requirements have been worked out through the combination of a variable speed transmission and a variable speed motor pulley, such as the double installation illustrated in Fig. 9. This machine is used

in filling containers for facial cream, lard, etc. These containers are brought under the filling pump on a short conveyor. Because of variations in the type and viscosity of the material, the pump must be operated at different rates of speed. This speed variation is accomplished by means of a variable speed transmission, lower left of Fig. 9, which is driven from the head shaft of the machine by a chain and sprocket arrangement.

Synchronizes Process Operations

The basic speed control problem is, of course, to synchronize the speed of container travel with the speed at which the product flows from the filler. A variable speed motor pulley, mounted with a 2 horsepower, 1800 R.P.M. constant speed motor drives to a 14-inch pulley on the head shaft of the conveyor and, in connection with the transmission, provides a speed range which helps to make possible a high production efficiency of the entire machine.

An outstanding example of the way in which the design of a machine may be improved through incorporation of a variable speed transmission is offered by a slasher recently developed by a manufacturer of textile mill equipment. Provision was made for the transmissions —four in number—when the slasher was in the blueprint stage. Hence the transmissions are built compactly into the machine. One drives and regulates the speed of the slasher as a complete unit; one drives and regulates a series of dry cans, and two units control a sizing tank and yarn tension rolls. These four units synchronize all parts of the machine, provide absolute control of yarn tension between the sections, reduce end breakage, save time formerly required to tie in broken ends and make possible increased production.

Two Transmissions Utilized

Two transmissions teamed together distinguish the design of an 8-reel winder used on an oil tempering outfit for brush wire. The large transmission, forming the main drive, is driven from a 5 horsepower, 1200 R.P.M. alternating current motor. This transmission varies the speed at which wire may be coiled on the 8 reels from 12.5 to 75 feet per minute, in accordance with variations in the diameters of the wire which range from .050 to .375-inch.

The smaller unit, operated from the variable speed shaft of the larger, drives a camshaft which actuates a "traverse" mechanism for each of the 8 reels. Each strand of wire is threaded through a hook-like traverse which shuttles back and forth across the face of the reel, coiling the wire evenly and smoothly. For wire of small diameter the traverse must be operated at slower speeds, while for a coil of large diameter it must make its trip at a higher rate of speed.

For their considerate assistance in the preparation of this article and for the illustrations included, MACHINE DESIGN wishes to thank the following manufacturers of variable speed transmissions: Lewellen Mfg. Co.; Link-Belt Co.; Reeves Pulley Co.; Smith Power Transmission Co.; and Sterling Electric Motors Inc.

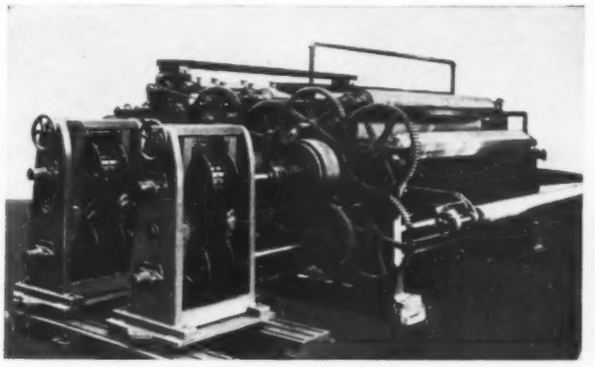


Fig. 11—Variations in sheet lengths are obviated on this paper cutter by use of a variable transmission

Articles on this and allied subjects published in previous issues of MACHINE DESIGN include:

"Incorporating Variable Transmissions in Machines," by D. W. Clem, July, 1930, p. 37.

"Smaller Drive Is Feasible with Differential Gears," by Ray T. Congleton, Sept., 1933, p. 11.

Noise Measurement Discussed

IN A recent issue of *Industrial Standardization* published by the American Standards association, Vern O. Knudsen, president, Acoustical Society of America, discussed proposed standards for the measurement of noise. Definitions have been proposed for 144 of the most important terms in the general field of acoustics and in various specialized cases. For the purpose of practical noise measurements and the design of sound or noise meters there is need for an additional loudness scale based on group judgment as to what constitutes a certain percentage in the loudness of sound. A number of investigations have been made for the purpose of obtaining such data and from results there can be derived relations which can be taken as the best indications of present material, with however, the essential recognition that they are tentative and may need modification as further data are obtained. In conclusion Mr. Knudsen states that as the technique of noise measurement improves and is standardized, means will become available for relieving our metropolitan population from the insidious noise of our mechanized civilization.

MACHINE DESIGN

L. E. JERMY, EDITOR
ALLEN F. CLARK
HAROLD B. VEITH
F. H. BURGESS

Design of Machinery Must Keep Ahead of Foreign Competition

THAT recognition of Russia will have favorable effects on machinery building here is undeniable. Steps already are being taken to set up credit arrangements that will pave the way to the placing of orders.

With Russians worshipping the machine as their God it is fortunate the decision to trade openly with them has been reached. It also is a good thing that the limitations placed on development of new machinery over here during the early days of the N.R.A. are "dying a natural death." For though Russia has a long way to go before it can hope to approach America in its manufacture and use of machines, it would be unthinkable that one country should put a damper on new development while another encourages it with unremitting force.

A simile of such a situation can be had from Japan. Much of that country's progressiveness is directly traceable to its construction and use of machinery—even to the extent of copying American designs. On the other hand, Japan's neighbor, China, where machines are given scant attention, has for years taken a back seat.

Any retardation, apart from purely internal considerations, in machine design and development will not long be countenanced in this country—a fact of which progressive manufacturers are duly cognizant.

• • •

Status of the Engineer

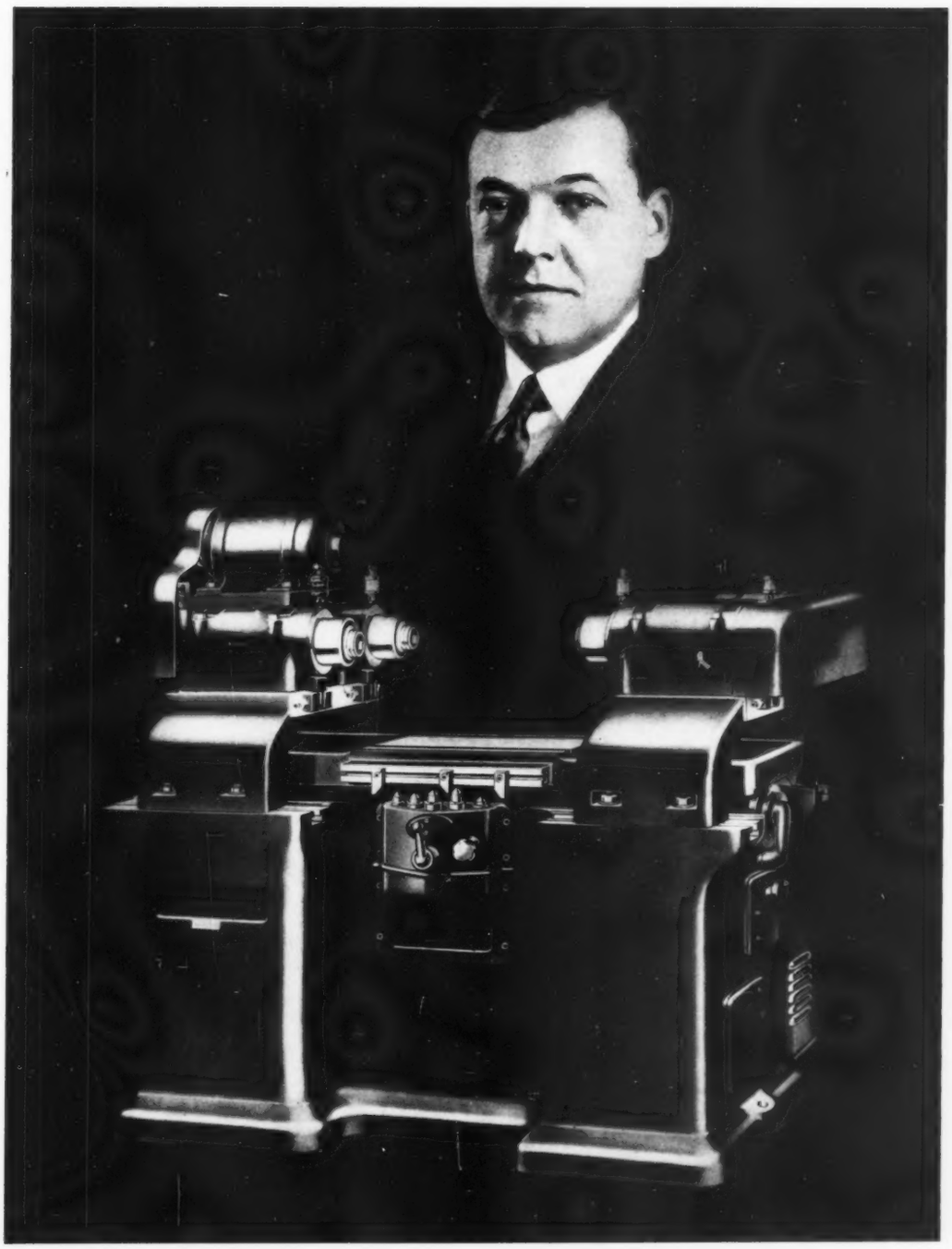
CAN the engineer be likened to the "forgotten man?" This thought has at least been expressed and there appears to be some grounds for it. Twelve months ago the engineer was being blamed for the ills of the world and had little to say in his defense. It was not until the banker and others came into ill favor several months later that disparaging comments on the engineer ceased to be voiced.

Fortunately a movement is on foot that may effect a change. The committee that has been formed by the major engineering societies, "Engineers Council for Professional Development," is set up to create ways and means whereby the engineer will be given due recognition and can improve his status professionally. Primarily, this effort is being concentrated on scholastic training with development and recognition of the engineer in industry as a further consideration. Support of this committee and the placing by it of greater emphasis on the latter aspect of its work undoubtedly would tend to put the engineer on the footing to which he is justly entitled.

MEN

and Their

MACHINES



PHIL HUBER AND HIS PRECISION BORING MACHINE

Men and Their Machines

WHEN an engineer strikes from his vocabulary the word "impossible" he takes an important step on the road to success. Phil Huber did this early in his technical career. That's the reason he was not discouraged when others told him he was attempting the impossible in trying to build precision boring machines that could bore steel as readily as aluminum, bronze or cast iron. As vice president and assistant general manager of Ex-Cell-O Aircraft & Tool Corp., Detroit, the development of this type of machine comes directly under his jurisdiction.

When a youth Mr. Huber was thrown upon his own resources by the death of his mother and father and had to get along as best he could. Later, at St. Joseph's college, he specialized in mechanical engineering. After completing his studies the machine tool industry afforded him employment; with Smith & Mills Co., Cincinnati, he gained experience in building shapers.

Then to the automotive industry with the Atlas Engine Works, Indianapolis, after which he became associated with Rumley Oil Pull Co. in the manufacture of tractors. This was valuable experience that later served him well at the Packard Truck Co. where he was engaged in an experimental capacity. Continental Motors, Dodge Bros. and Ford, respectively, acquired his services during succeeding years.

Early in 1919 Mr. Huber became one of the original group that organized the Ex-Cell-O company. Five years later he became actively associated with it and since 1928 has devoted all his efforts to boring machine design and manufacture.

Possessing the true executive instinct, Huber fulfills the axiom that a man should strive constantly to improve himself for the job ahead. He has done this, rising thereby to a commanding post in his organization.

Combination of the practical side of any design with the theoretical is one of his precepts. For example, the first question he asks in considering the control of a particular machine is, "How easy will it be for the operator to manipulate?" Facilities whereby the machine may be serviced conveniently and with a minimum of expense also are first considerations in his work as a designer. And appearance as well is taken into account. Thus do Mr. Huber's activities offer a high standard of engineering zeal and action.

Metalworking Machinery

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments and Questions from Our Readers. Machine Design Welcomes Letters or Solutions to Problems Suitable for Publication

Employ a Piece Rate System?

To the Editor:

THIS business of the establishment of a piece rate system for designers, besides being an important topic for consideration, has proved to be an especially interesting subject for discussion. I believe that insofar as detailing and repetitive tasks are concerned, there is no bar to successful installation of piece work plans. For design jobs and wholly creative tasks, the problem becomes more intricate; for after all it is difficult to measure the activity of the human brain. However, it seems to me that if a careful analysis of past design jobs were made from a viewpoint of time and effectiveness, a key factor or standard unit would develop which would serve as a standard of measurement. This, of course, might not lend itself toward a strict piece work plan; but, having personally set up wage payments, I am sure some form of bonus, premium or other form of wage payment could be devised.

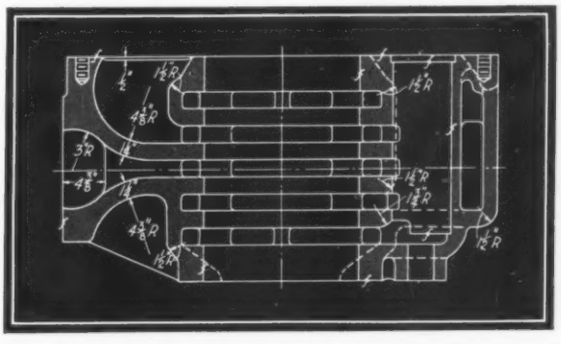
—J. M. MURPHY,
Lakewood, O.

Simplifying Cross Sectioning

To the Editor:

CROSS sectioning is a bothersome detail affiliated with design that usually consumes considerable time. A great deal once was written on this subject, but with the general use of pencil tracing, interest seemed to die out. To show how time can be saved on this operation, I would like to submit the accompanying drawing, cross sectioned in a seat and novel manner and an exceedingly economical one. We are using this type of cross section on all our details. The men in the shop find it much plainer than the former methods.

Now as to the trick in making this cross sectioning: After the detail drawing is completed, remove the tracing from the board and place it face down on the back of a knurled surface, such as a book or a metal plate, and rub over with a blunt lead pencil. The variety of designs is limitless and a standard for types of material can be compiled. As the sectioning is on the back, complete detail can be cross sectioned and then an eraser used to take out sectioning around dimensions or important arrows, etc. Also, any alterations on the face of the tracing do not



Unique method of cross sectioning permits changes without smearing the drawing

effect or smear the cross sectioning which remains as neat as when first completed.

Try it and see how rapidly and easily it can be done!

—J. HOWARD MCCORMICK,
Buffalo, N. Y.

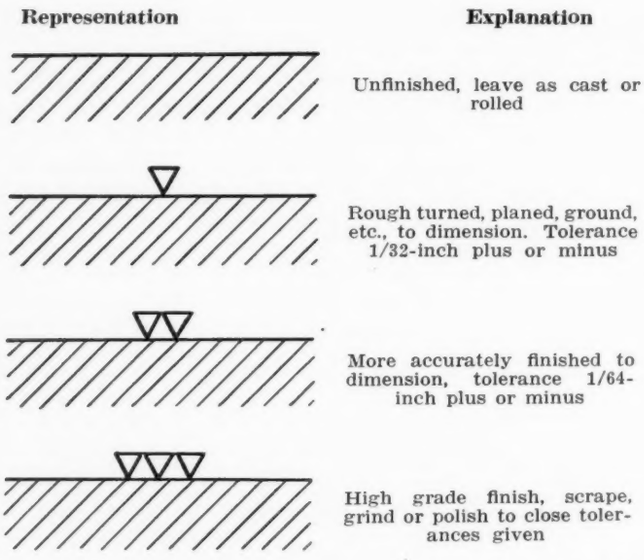
Specify Finish Exactly!

To the Editor:

THE present method of indicating machine finish on drawings by an *"f"* crosswise on a line leaves something to be desired. While it is most commonly used, it does not specify what degree of finish is to be given, nor does it tell, in terms of tolerance, how closely to dimension the

work is to be done, a valuable point.

Looking around us to see what others are doing, we find in England the more general custom of drawing a red line next to the surface to be finished. This practice came down from days when drawings were made on heavy manilla paper and given to the shop to work by.. Since blueprints were introduced, and now that we have red and black line prints that can be


Representation
Explanation
Unfinished, leave as cast or rolled
Rough turned, planed, ground, etc., to dimension. Tolerance 1/32-inch plus or minus
More accurately finished to dimension, tolerance 1/64-inch plus or minus
High grade finish, scrape, grind or polish to close tolerances given

Confusion existing under present system of indicating finish can be eliminated by improved designations

printed as clearly as a tracing, the red line ceases to have its original meaning. The patternmaker saw the red line on the manilla paper and knew he had to leave finish, and the machinist knew that there was some machine operation to be done.

System Is Widely Used

Later, in Continental Europe, the system here shown was developed and is now in wide use by the largest shops. The advantages obtained are both degree of finish and tolerance. Translated into our own customs, we find first the representation of an unfinished surface. Next we find a small equilateral triangle used to indicate rough machining to dimension with an appropriate tolerance of say 30 thousandths plus or minus. This is used where a part is to be finished either for mere clean appearances, or for a running clearance between two parts without danger of rubbing contact. Then comes a better grade of finish with closer tolerance, indicated by two triangles. Finally the most accurately finished surface, ground, scraped, or polished to "mike."

This system has several advantages; it is easily learned, it can be printed in each drawing in a small corner, so that if a drawing has to be sent out for estimate, work to be done, etc., to a strange shop, the whole story is there at once and there is no good excuse for ignorance. There is the further fact that it does not take any longer while making the drawing, and that it conveys a visual idea of a tool point going over a surface once, twice or three times, according to the requirements of finish; more or less conventional, but helpful nevertheless.

Those of us who get their tracing paper and cloth with printed borders, nameplates, revision blocks, etc., will do well to consider printing this code in condensed form in a corner, and posting a large chart in several parts of the shop.

—JOHN S. CARPENTER,
Detroit

Editor's Note: This proposal, covered previously in MACHINE DESIGN, is gaining headway. It should appeal to the American Standards association or, first, to the standardization committees of engineering societies.

Locating Drawing Changes Easily

To the Editor:

MINOR changes on drawings are both frequent and necessary in order to keep the tracings up-to-date, but such changes present a routine problem that demands a disproportionate amount of attention.

It is customary to designate each change by a number on the change slip and to note this number on the tracing at the point where the change has been made. On larger drawings the practice is often that of placing change numbers on the margins of the drawing in such a way that vertical and horizontal lines through the margin numbers will intersect at the point where the change has been made. This practice facilitates reading, but it gives the drawing a "cluttered-up" look.

This disadvantage can be overcome and the benefits retained by the use of the following method. The designer records on the change slip, in addition to the usual information, a number which indicates the location of the changed part. This number is selected by mentally dividing the top and side of the drawing into ten equal parts using the lower left corner of the drawing as the origin. For example, if the change slip carries the number "26" it indicates that the change is located on or near the intersection of a vertical line two-tenths of the length of the drawing from the left hand edge, with a horizontal line six-tenths of the drawing height up from the bottom.

—THEODORE C. BENNETT,
Philadelphia

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

Historical Material Collected to Show Engineering Evolution

FOUR projects of interest to the engineering profession are being sponsored by the Society for the Promotion of Engineering Education through its division of engineering drawing and descriptive geometry. The series covers: A collection of material depicting the evolution and variety of instruments used in engineering drawing; a collection of old drawings intended to show the development of engineering drafting room practice; the work of writers, old and modern, on the subject of drawing and descriptive geometry; preparation of a series of bulletin board posters carrying a portrait and biography of persons prominent in history of engineering with excerpts from their writings emphasizing the value to engineers of training in engineering drawing.

* * *

New Program to Advance Status of Engineering Profession

AMONG the most constructive programs that have ever been presented anywhere for advancing the status and recognition of the engineering profession—that is the way representatives of education and industry regard activities of the Engineers' Council for Professional Development. This organization is a direct outgrowth of the work of the committee on the economic status of the engineer. Following the recommendations of the latter group, the American Society of Mechanical Engineers by which it was sponsored, invited other national societies to appoint representatives to meet and discuss the project. Thus a joint body was inaugurated and a general plan involved.

Chairman of the Engineers' Council for Professional Development is Dr. C. F. Hirschfeld. At a recent meeting he stated that industrialists and others who hire and who use engineers in large numbers are complaining that the engineer is too single-tracked an individual, that in general, he knows one thing well and most others not at all. Dr. Hirschfeld's view, however, is that the engineer has dealt with problems amenable to factual attack. Working in this way he has advanced our civilization lopsidely in that he outstripped the workers in other fields in which factual methods of attack have not been developed or possibly in some in which they are not applicable.

He sees nothing really alarming in this. Human progress has always been made by means of wedges driven ahead of the general line of progress. Dr. Hirschfeld is satisfied that we cannot get along without the engineer and his advances; therefore the wedge cannot be lopped off. We shall have to maneuver so that the line catches up, he contended.

* * *

Discover Industrial Applications For Soil-Heating Cable

TWO out-of-the-ordinary installations of soil-heating cable have been made by Cleveland industries, according to General Electric engineers. The cable—nickel chromium wire covered with asbestos, taped with varnished cambric, and encased in a lead sheath for protection from moisture—is designed primarily for horticultural and agricultural uses. A steel plant had difficulty in the winter time with its lubricant for roll-neck bearings, which congealed in the pipe lines. Formerly a steam pipe or air duct was nested with the pipe lines; now soil-heating cable has been wound around the pipes and insulation applied. An automatic, adjustable thermostat maintains the temperature of the lubricant at the proper point, irrespective of the weather conditions.

* * *

Carbon Steel Casting Specifications Are Approved as Tentative

CONSOLIDATED specifications for carbon steel castings for industrial, railroad and marine uses recently were approved for publication as tentative by the American Society for

(*Concluded on Page* 46)

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

BECAUSE designers from time to time have contact with the patent office they will be interested in a brief resume of the career of Conway P. Coe, newly appointed commissioner of patents. Probably the youngest man ever to serve in this capacity, the selection is typical of "New Deal" appointments.

Maryland is Mr. Coe's birthplace. After graduating from high school in Washington he entered Randolph-Macon college at Ashland, Va., graduating with a bachelor of arts degree. In 1918 he first became employed in the United States patent office and was assigned to division 35 as assistant examiner. After a few months he resigned to enlist in the field artillery at Camp Zachary Taylor.

When the armistice was signed and he was discharged from the army, he became employed by one of the large rubber companies. Later (1919) he was reappointed assistant examiner and assigned to division 11, handling automatic shoe lasting machine patents. During this period he entered George Washington law school and was graduated with an LL.B. degree.

Finishing law and passing the bar, Mr. Coe joined a patent law firm in Akron, O. This was early in 1923. After about eight months of practice there he returned to the patent office. A short time later he opened an office in Washington and continued private practice until his recent appointment as commissioner.

PRESIDENCY of the newly organized Mechanical Press Builders association has been conferred on Howard U. Herrick. He is recognized as one of the best informed men in this country on design, construction and use of all types of power presses, thread rolling machines and automatic feeds for such units.

Born in Syracuse, N. Y., Mr. Herrick went to work for the Smith-Premier Typewriter Co. after completing his school education. Subsequently he joined the Syracuse Time Recorder Co., and then became associated with C. E. Lipe Corp., Syracuse. Packard Motor Car Co., Detroit, next engaged him. Later he took charge of the manufacture of steering gears and gear shifting controls for the Brown-Lipe Gear Co. He became works manager and had entire charge of the gear company's plant for five years.

In 1924 Mr. Herrick accepted a position with the V & O Press Co., Hudson, N. Y., as vice president and general manager. Two years later he was appointed president and in 1928 was assigned the additional duties of treasurer.

ONE of the organizers of the new Packaging Machinery Manufacturers Institute Inc., a director of this group for three years, and chairman of the code committee . . . . is H. H. Leonard. Indicative of this executive's ability in organization is the fact that he was one of the founders of the Consolidated Packaging Machinery Corp., Buffalo, in 1924. He now is its vice president and general manager.

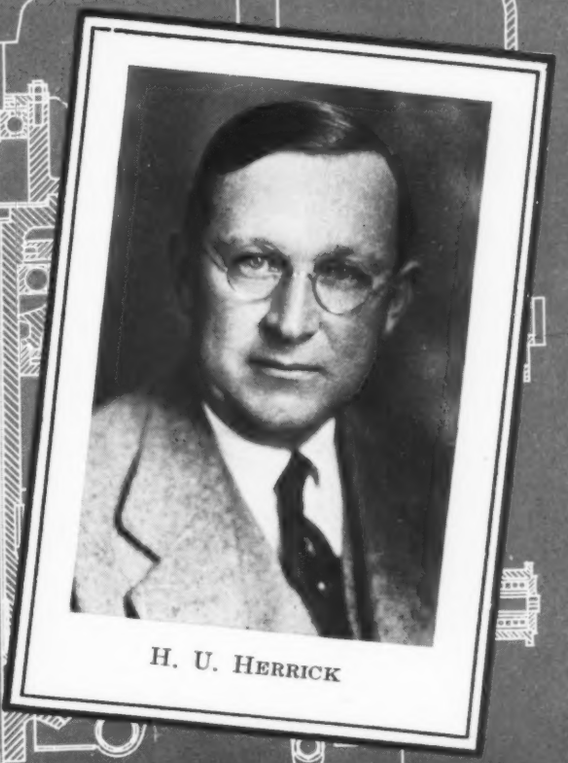
Graduated in mechanical engineering from University of Maine in 1901, Mr. Leonard for a number of years was a designer of automatic machinery for the Draper Corp., Hopedale, Mass. Later he supervised the design of tools and fixtures for Yale & Towne Mfg. Co.

Following a period with the American Hardware Corp., New Britain, Conn., where he was engaged in the development of special processes and equipment, he was for ten years works manager of the Turner & Seymour Mfg. Co., Torrington, Conn. The Stamford Rolling Mills, Stamford, Conn., next obtained his services as assistant general manager. Subsequently he took part in the formation of the company with which he now is affiliated.

WITH his appointment as director of research of Bell Telephone Laboratories in August of this year, Oliver E. Buckley is given a wider scope for his research and executive abilities that have benefited the telephone in-

Leaders in Design, Engineering and Research

CONWAY P. COE



H. U. HERRICK

H. H. LEONARD

O. E. BUCKLEY

dustry for a number of years. He was graduated from Grinnell college in 1909. Remaining there as an instructor a year, he entered Cornell where he combined instruction with graduate study. The degree of doctor of philosophy was conferred upon him in 1914.

Joining the engineering department of Western Electric Co., Dr. Buckley became a research physicist. During the World war he went to France and was given charge of the research section of the signal corps, A. E. F., in Paris. He held the rank of major, and after demobilization initiated a successful investigation of submarine telegraph cables at Bell Laboratories.

On March 1, 1927, Dr. Buckley was appointed assistant director of research. Extension of his responsibility to include research in telephone transmission brought him into contact with a wider range of problems and furnished the broader experience necessary in his present position. Dr. Buckley is a member of the Franklin institute, the American Institute of Electrical Engineers, the American Association for the Advancement of Science, and American Physical society.

* * *

John Gaillard, mechanical engineer on the staff of the American Standards association, has been awarded the degree of doctor of technical science by the Technische Hoogeschool (Institute of Technology) of Delft, Holland, where he was graduated before he moved to the United States and became an American citizen.

* * *

T. A. Bryson, who was chief engineer of the Tolhurst Machine Works prior to its reorganization, has become chief consultant to the American Tool & Machine Co., on centrifugals.

* * *

W. H. Urquhart has been appointed consulting engineer of Goodyear Tire & Rubber Co., Akron, O., to succeed the late W. C. State.

* * *

Norman L. Daney recently was appointed general manager of Harris-Seybold-Potter Co., Cleveland. His early experience includes a number of years in engineering departments.

* * *

Guglielmo Marconi, inventor of the wireless and a senator of Italy, recently received the honorary degree of doctor of laws at Notre Dame university in a special convocation.

* * *

Dr. Colin G. Fink, professor of electrochemistry at Columbia university, New York, has been elected to receive the Perkins metal of the Society of Chemical Industry for 1934. The award is for Dr. Fink's inventions in the fields of metallurgy and electrochemistry.

* * *

O. E. Hunt, vice president of General Motors Corp., Detroit will function in an advisory capacity to W. S. Knudsen on engineering matters.

* * *

Capt. Arthur Boor recently became connected with Monroe Auto Equipment Co., Monroe, Mich., as chief engineer.

* * *

Norman Bel Geddes designed the medallion commemorating the twenty-fifth anniversary of General Motors Corp.

* * *

Frank Conrad, assistant chief engineer, Westinghouse Electric & Mfg. Co, East Pittsburgh, Pa., has been awarded the John Scott medal by the city of Philadelphia. Scientific achievement in radio development won him the award.

* * *

Harold T. Youngren recently was appointed chief engineer of the Olds Motor division of General Motors Corp. His picture and biographical sketch will be presented next month. Charles A. Chayne succeeds Mr. Youngren as assistant chief engineer of Buick Motor Co.

Obituaries

Henry H. Westinghouse, chairman of the board, Westinghouse Air Brake Co., died recently following a long illness. He was the last surviving brother of George Westinghouse who succumbed in 1914. Henry Westinghouse inherited a talent for mechanical development from his father and in 1883 invented the single-acting steam engine. When he had patented this unit he founded the Westinghouse Machine Co. and in 1885 organized the engineering firm of Westinghouse, Church, Kerr & Co. Mr. Westinghouse was born Nov. 16, 1853, in the village of Central Bridge, New York.

* * *

Edward T. Birdsall, the central force in the organization of the Society of Automotive Engineers, died recently in New Rochelle, New York. He was its first secretary. At the beginning of the century Mr. Birdsall was associated with the Desberon Motor Co., Brooklyn, as an engineer in the development of a steam truck which, however, did not reach the commercial stage. He was a graduate mechanical engineer, obtaining his degree from Stevens Institute of Technology in 1886.

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

REFINEMENTS in a machine for boxing matches have been developed by Karl Gregory for Diamond Match Co., Baltimore. The mechanism is intended to obviate interference of overcharged match box trays with the box covers during assembly of these covers on the trays.

Referring to Figs. 1 and 2, 13 designates a push bar which is reciprocated transversely of match tray carrier 10 during the intervals of rest of the two carriers 10 and 11. This bar has a rising and falling motion during reciprocation. Head 14, which is lowered at the forward position of the bar, bears against filled tray *T*, Fig. 2, and advances it into throat piece 12 in nesting relation with cover *C*.

A pendant tongue 27 is carried by a pintle 28 which is supported in and between spaced brackets 29 on throat piece 12. This tongue terminates in a lip 30 that is swung upward by contact of hold-down blade 21, in a manner to bear

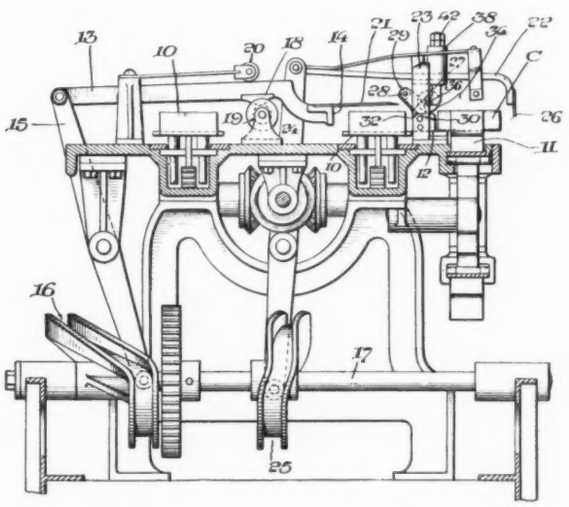


Fig. 1—Mechanism designed to obviate trouble in assembling cover on match box trays

against the opposing underside of the upper wall of the positioned cover *C* in the throat piece. Thus is insured the opening of the receiving end of the cover and the guidance of the tray into it.

Tongue 27 and lip 30 are slotted as at 31, Fig. 2. Spring-pressed roll 34 having a horizontal axis of rotation, is positioned directly above the throat piece. It is in co-operative relation to the path of the upper surface of hold-down blade 21 and the slot of the swinging tongue when the tongue is lifted to its active position by contact with the advancing blade. Hence if the blade 21 should happen to be canted or inclined by its contact with excess contents of the tray, the tip of the blade will be pressed downward by the opposing roll to permit the blade to pass under the lip of the tongue and into the cover without danger of raising it at the risk of rupturing the upper wall of the cover. The patent is designated 1,928,195.

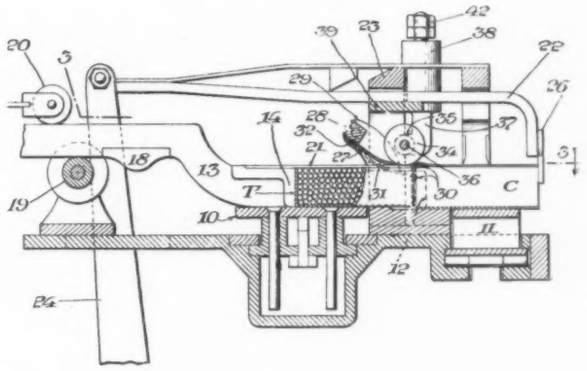


Fig. 2—Spring-pressed roller prevents canting of hold-down blade by over-filled box

USE of a coil of the contractable type is a feature of the friction clutch recently granted patent No. 1,930,482. The invention was made by Oscar L. Lawson, with United Shoe Machinery Corp., Paterson, N. J., assignee of the patent. Driving member 5 is driven continously by gear 7 and has a hub 9 which is encircled by a contractable coil 11 of spring steel, as shown in Fig. 3. Driven member 13 has a cup-shaped portion extending over the coil, and a hub that is fastened to shaft 3 by set screws 15.

Integral with coil 11 are two lugs, 17 and 19, located at each end of the coil. Member 13 is formed with a hollow boss to receive the lugs loosely. Lug 17 is prevented from movement by stop screw 21 threaded through member 13. Lug 19 is engaged by one end of a pin 25 slidable in

a bore in driven member 13. The other end of the pin is held by spring 26 in contact with the operative end of a two-armed lever 27 pivoted about pin 29. Consequently when lever 27 is rocked in a counterclockwise direction as viewed in the top drawing, Fig. 3, the coil is contracted about the hub of the driving member 5 and shaft 3 is rotated.

This rocking movement is accomplished by means of a second two-armed lever also pivoted about pin 29 and having two arms 31 and 33. In order to actuate arm 33 a spool 39 which is

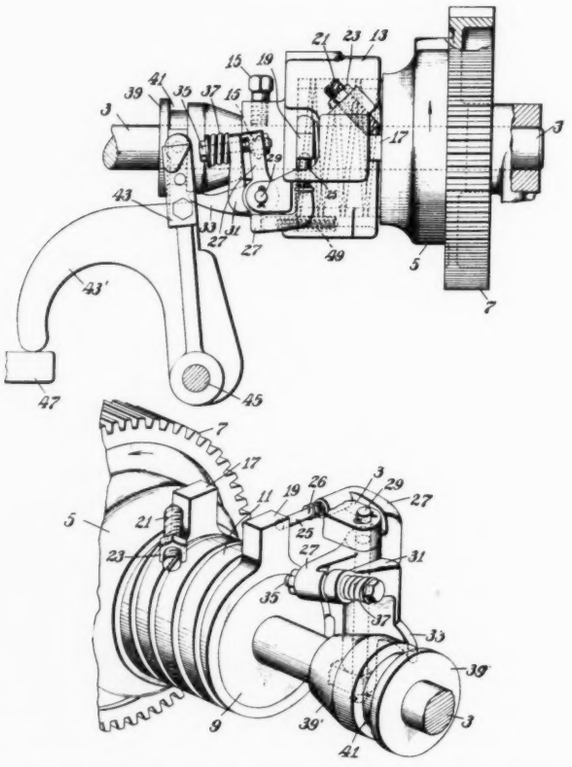


Fig. 3—Contraction of spring steel coil effects drive in operation of clutch

loose on shaft 3, has a tapered portion 39′ to engage free end of the arm. The spool has a groove 41 to receive rolls carried in the usual manner by arms of shifting fork 43. Movement of the treadle 47 actuates the clutch.

AUGMENTING the various types of motor mountings already described in MACHINE DESIGN, the design recently patented and presented herewith is particularly unique. George R. Goldthwaite invented the suspension for B. F. Sturtevant Co., Hyde Park, Mass., to provide an arrangement which will absorb starting torques and vibrations set up by motors and fans. Noise and hum are substantially eliminated.

The device, Fig. 4, comprises an overhung three-quarter loop spring 10 rigidly attached at

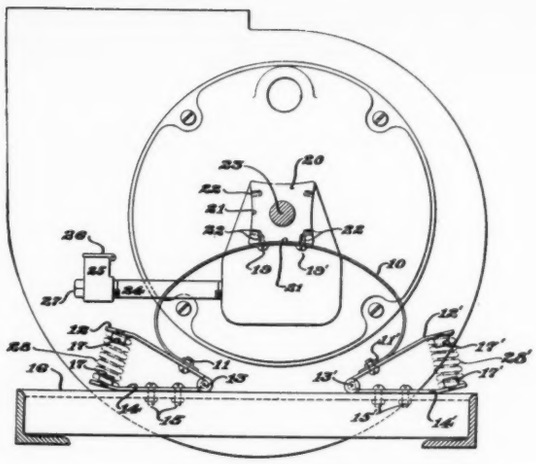


Fig. 4—Loop spring serves as motor mounting for absorbing torque and vibration

its ends by bolts 11 to members 12 that are pivotally mounted at 13 upon metal plates 14. These plates 14 and members 13 are provided with bosses to receive spiral springs 28. Motor bearing 20 is cast integral with the end plate of the motor frame.

Motor and fans are mounted on the suspension and fixed by bolts 19 and 19′. When the circuit is closed vibrations due to the motor and to any imperfection in the balancing of fan blades are communicated to the overhung three-quarter loop spring, presumably setting up transverse waves and longitudinal oscillations therein.

From experimental results the conclusion follows that whatever may be the character of these waves and oscillations, they are effectively damped out when they reach the portion of greatest curvature of the loop overhung spring. Consequently they do not communicate any substantial amount of energy to pivots 17 and to support 16. Use of this device results in almost complete elimination of all sound of operation. Number of the patent is 1,930,971.

ENGINEERS confronted with vibration problems in crankshafts, will be interested in a new vibration eliminator patented by D. D. Stone for General Motors Corp., Detroit. It holds several interesting ideas. The device shown in Fig. 5, does not require any elongation of the shaft to provide for its application. Comprising the vibratory mass of the units are two ring-like halves 13 and 13*a*, meeting end to end to form a continuous balancer ring devised to oscillate in bearings on the end of a double crankarm.

In order to resist strains, the body 22 is provided with rabbeted edges at 27, and the bal-

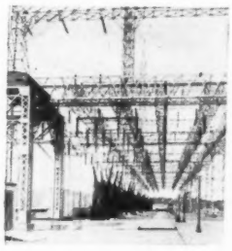
(*Concluded on Page* 60)

MODERN MACHINERY CALLS FOR MODERN METALS

NICKEL...

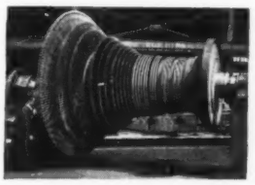
POINTS THE WAY TO GREATER ECONOMIES IN LIGHT, HEAT AND POWER PRODUCTION

THE insistent demand for lower costs forces the power plant engineer to push metals and machines to the limit—to subject them to higher temperatures,

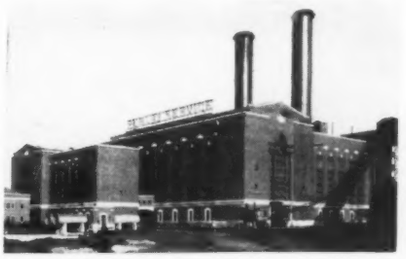


higher pressures, higher speeds. Under conditions such as these the ordinary metals will not suffice—recourse must be had to strong, tough alloys or alloys particularly resistant to heat and corrosion.

When nickel is correctly alloyed with other metals a wide range of improved properties is obtained—properties that assure increased resistance to the destructive forces of heat, stress, fatigue, erosion, corrosion, abrasion, wear. By taking advantage of these improved properties, progressive engineers are enabled to design and construct machinery and equipment that is more efficient, more enduring and more economical to operate and maintain.



The alloys containing Nickel embrace a variety of compositions, each carefully determined by exhaustive laboratory and service tests. Wherever equipment is thoroughly modern you are certain to find Nickel Alloy Steels, Nickel Cast Irons, Nickel Bronzes, Stainless Steels, etc., serving a wide variety of purposes. In power plants they are used for rotor blades and shafting; for steam cylinder castings, piston rods, fittings, valves,



bolts; for bearings and packing; for grate bars, meter parts, and for scores of electrical, rotating and sliding applications.

Their use, however, is by no means confined to these industries. Alloys containing Nickel are widely employed today in every industry where machines require metals of greater endurance and greater dependability. And when you consider all the advantages of alloying with Nickel, the extra cost is really small in relation to the benefits secured. In many cases only a little Nickel (from ½% to 5%) is required to produce definitely superior mechanical properties.

Moreover these alloys containing Nickel are easy to secure. They are commercially available *in a variety of compositions* in all important metal consuming centers. If you are planning to build new equipment or modernize the old, our engineers will be glad to advise you concerning the most suitable applications. You may feel free to consult our technical staff at any time regarding your problems.

Nickel Alloy Steels

Among the most notable materials in extending the life of machinery are Nickel Alloy Steels. A typical application in the Light, Heat and Power industry is pictured at the left. This Nickel Alloy Steel spindle for 75,000 kw. 1800 R.P.M. turbine is unusually strong, tough and stress-resisting. More and more of this superior material is being used every year in the country's leading industries.

THE INTERNATIONAL NICKEL COMPANY, INC.

Miners, refiners and rollers of Nickel. Sole producers of Monel Metal.

67 Wall Street New York, N. Y.

Topics of the Month

(*Concluded from Page* 39)

Testing Materials. Certain confusion had arisen previously due to the fact that the specifications for carbon steel castings had varying requirements for the same grades of steel. The steel is to be made by one or more of the following processes: open hearth, electric furnace, converter or crucible. Detailed requirements for heat treatment and other data are included in the recommendation.

* * *

Temperatures at Flying Altitudes Do Not Affect Metals

AN EXTENSIVE series of tests made in the laboratories of the U. S. Army Air Corps revealed recently that extremely cold temperatures encountered in flying at high altitudes do not sufficiently affect the properties of strong and tough metals to endanger the safety of the plane. Tests were made to determine tensile strength, hardness and other properties. Standard temperature of tests selected was —40 degrees Cent. which corresponds approximately to an altitude of 30,000 feet. Materials investigated included five nickel chromium stainless steels, a number of aluminum base alloys and magnesium base alloys. Results indicated that the designer is safe in using, for aeronautical construction, permissible stresses as determined by testing materials at normal temperature.

* * *

Cars Do More, Drivers Less, in New British Auto Trend

THE approach of annual automobile shows is creating much speculation regarding mechanical features to be embodied in new models; as yet little definite data is available. In Great Britain the Olympia show already has been held and as in America, the trend in 1934 British models reveals cars that will do more, while drivers do less. Convenience and comfort are chief considerations. Independent wheel suspension appears on additional Alvis and Sunbeam models. The Wilson self-changing epicyclic system has acquired several new adherents. In this design the gears are preselected, usually by means of a lever on the steering column, and then are caused to engage when required by depressing and releasing a pedal. Synchromesh also has gained headway, and freewheeling has become more popular in England. Besides reducing mechanical noises, air noises have been lessened considerably by streamlining, which also of course increases efficiency. A pedomatic engine starting device also has been introduced, similar to the accelerator starting pedal.

* * *

Gray Iron Institute Is Given New Name by Directors

GRAY Iron Founders' Society Inc. is the new name selected to replace that of the Gray Iron Institute. This action was taken by members of the board of directors recently. They also voted to make certain changes in the by-laws of the organization so that the industry might function more efficiently under the National Recovery Act. Among other advantages the change in name unifies the style of three of the national trade organizations in the foundry field, namely Malleable Founders' society, Steel Founders' society and the Gray Iron Founders' society.

* * *

Believes That Future Automobiles Will Have Three Wheels

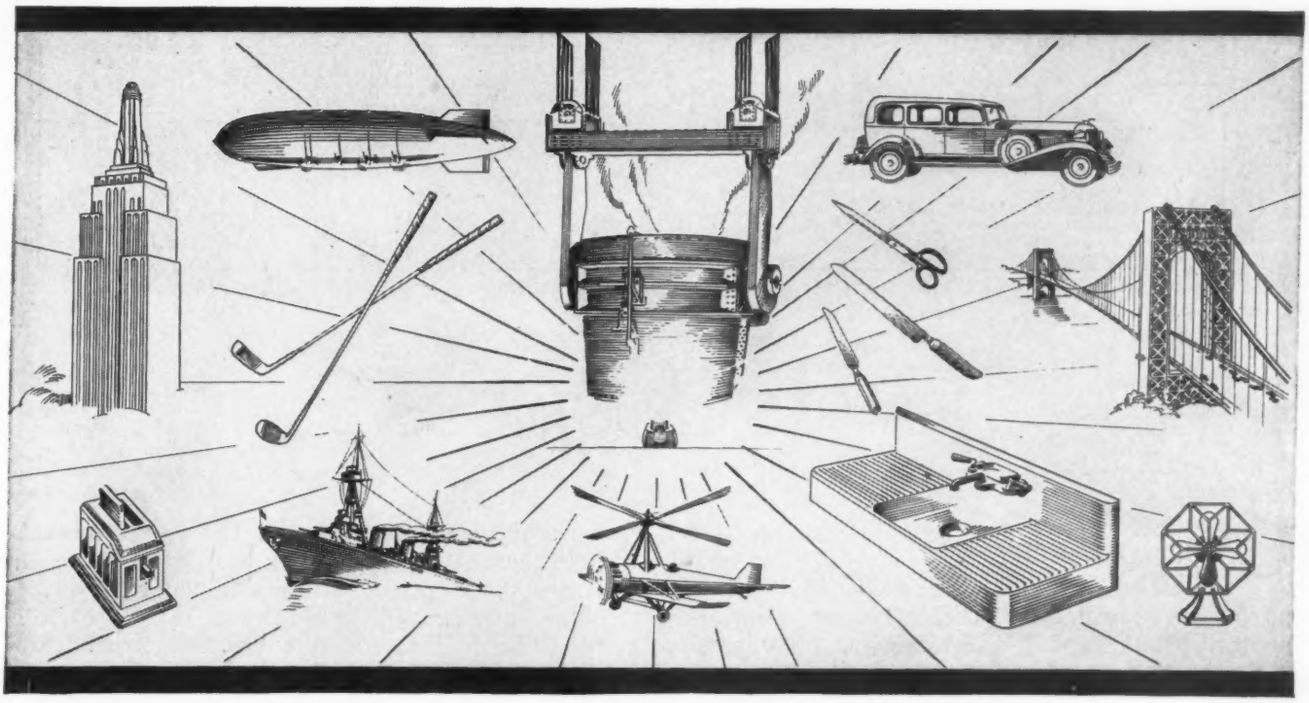
THREE road wheels, reduced frontal area, and the engine in the rear . . . thus was the automobile of the future pictured by Frank S. Spring, Detroit automotive engineer, to the Canadian section of the Society of Automotive Engineers recently. Because it is not possible to design a perfectly streamlined car with four wheels, asserted Mr. Spring, one rear wheel will be eliminated. He ventured the prediction that engineers eventually may develop a car that can take-off from the ground and fly.

* * *

Increase in Borrowing of Books Shows Mass Intellectual Movement

FIGURES presented at the recent annual convention of the American Library association in Chicago revealed four million new borrowers of public library books including technical works, since 1929. This indicates a mass intellectual movement which is further borne out by the thousands of unemployed who are rushing to take advantage of the opportunities for further education from primary to college courses provided by state agencies.

ELECTROMET SERVICE



Eliminates Uncertainty in Selecting ALLOY STEELS

There are so many alloy steels to choose from that selecting the best to use in your equipment is not an easy matter. If you are trying now to determine which of the many alloy combinations can best meet your needs, the unique assistance that Electromet offers may be just what you are looking for:

As the pioneer producer of ferro-alloys and metals for steel makers, Electromet has available, and will furnish without charge and without bias in favor of any one composition or producer, the facts you need to insure utmost returns from your investment in alloy steel. Before you write your specifications, take advantage of this service. It may save you money and disappointment. Write today for complete information.

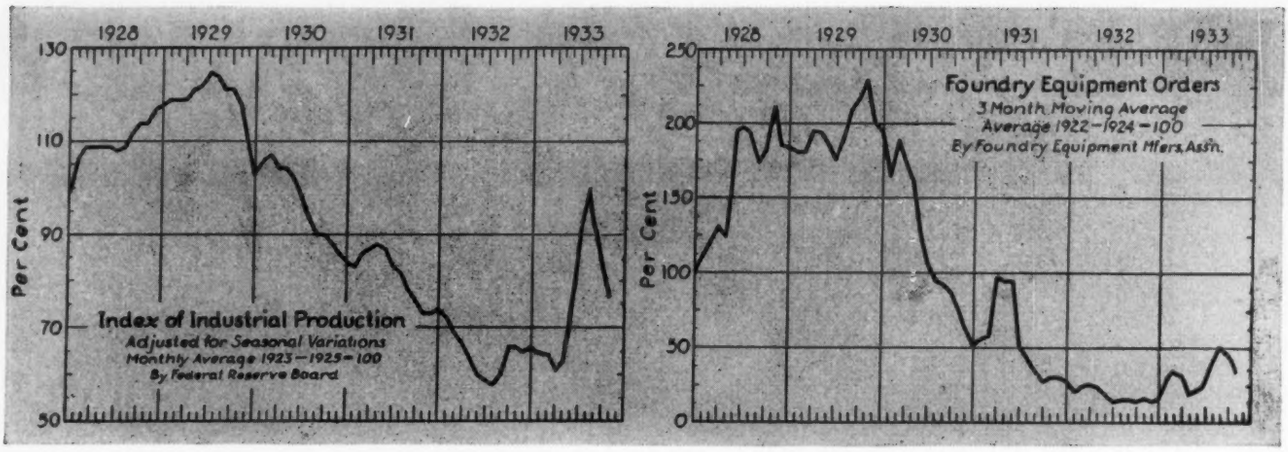
Electromet
Ferro-Alloys & Metals

NRA MEMBER U.S. WE DO OUR PART

ELECTRO METALLURGICAL SALES CORP.
Unit of Union Carbide and Carbon Corp.

UCC

Carbide & Carbon Building, 30 East 42nd Street, New York, N.Y.

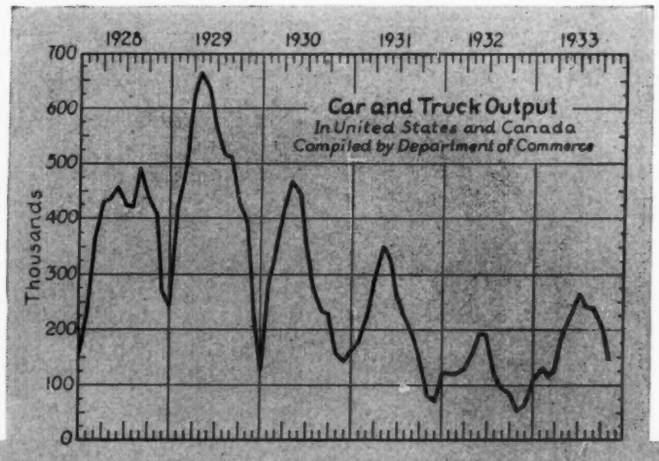


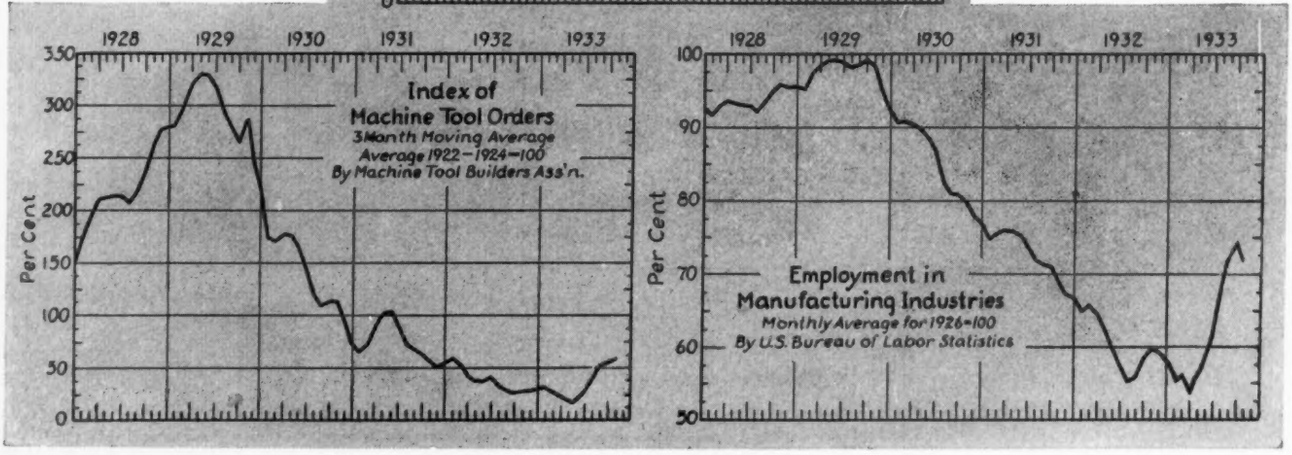
How Is Business?

ON TWO occasions when uncertainty, doubt and fear were widespread the President visited his neighbors and calmly stated his purposes, reassured his friends and, most important of all, dispelled their fears. Now, again, a policy has become the center of attack. It would seem that another visit is necessary.

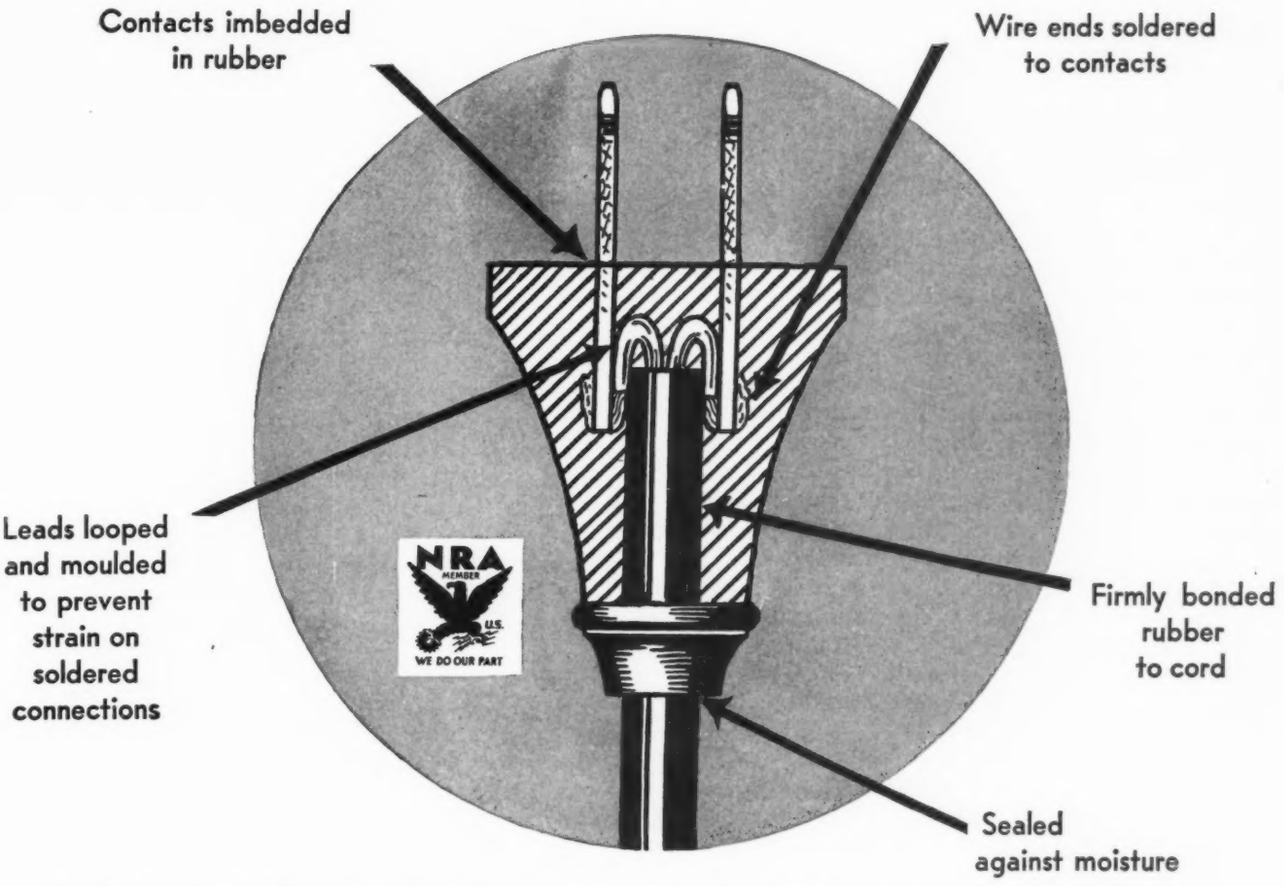
The aim of the government's monetary plans has been explained and re-explained, yet the method of securing these ends has created considerable confusion, thus retarding business somewhat. The attacks on the present activities have been bitter, and have been backed by reputable financial leaders, but there is another point to be considered—perhaps these attackers see the government's policies in the light of personal desires, rather than considering the ultimate general benefit.

Mere mention of inflation conjures horrible pictures in the mind of business leaders, similarly unrestrained inflation is repugnant to Treasury advisers. It should be remembered that the ultimate goal of the present monetary policy is to return to a gold backing for the dollar. Stabilization is ardently desired by those in power, but they intend to stabilize only after a proper world-wide currency balance is achieved. Meanwhile certain business indexes, for example, the index of machine tool orders, show continued improvement.





G-E ALL-RUBBER PLUGS
ARE MOULDED ON THE CORD
NOT SIMPLY ATTACHED


Contacts imbedded in rubber
Wire ends soldered to contacts
Leads looped and moulded to prevent strain on soldered connections
Firmly bonded rubber to cord
Sealed against moisture
NRA MEMBER U.S. WE DO OUR PART

Each General Electric all-rubber plug and its cord is of one piece construction. The plugs are *not molded separately* and then attached to the cord. *The plug and the cord are one piece.* Thousands of pounds of pressure are applied at low temperature during the molding process to safeguard the life of the rubber and to bring about this one-piece construction. This is why G-E All-rubber plugs outlast the cord.

G-E All-rubber plugs and cords are built to stand hard wear and rough usage. Walk on them . . . hammer them . . . drive over them . . . and they are still ready to do their job. Use them to eliminate all your plug and cord complaints.

G-E cord sets with all-rubber plugs molded on will add quality to your appliances — increase their value. They can be molded on any type of silk, cotton, rubber, asbestos or heater cord. They carry the Underwriters' Laboratories' Label of approval. For further information and estimates write Sec. QR-3412, Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

ACCESSORY EQUIPMENT

MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

Meeting Service Conditions in Refrigerator Design

(*Concluded from Page* 26)

sealed into the compressor shell by electric arc welding in a dished end head as shown in Fig. 1. If it is necessary to salvage a unit the weld is turned off and the end head is removed. When ready to reassemble, the shell and head are used again and another weld made.

Spring Mounting Employed

The finished compressor is spring mounted on a three-point suspension to reduce noise, a particularly vital problem in refrigerator design because the refrigerator must operate inside living quarters and not be noticeable at any time. A number of details must be carefully controlled to keep noise to a minimum. Single bearing construction insures perfect alignment and a uniform air gap. Head clearance is carefully adjusted and the piston wall clearance rigidly held. The crank pin and wrist pin clearances are set to the proper values shown by test. Mufflers are used in both the suction and discharge line. The entire mechanism is hermetically sealed in a steel shell which also serves to reduce noise. A closed top fin design is used because it gives less vibration than the usual open type of fin. The entire unit is finally mounted on a resilient gasket in a chamber lined with sound absorbing surfaces. Quietness is not obtained by any single improvement in design, but by unceasing attention to details and rigid control of the assembly of the unit in the shop.

They Say—

"Concerns that are consulting with their salesmen on matters of selling and merchandisig are finding it entirely profitable and worthwhile. It's a short-cut to the elimination of a lot of mistakes that cost plenty to correct after the final dies or designs or plans are made and in use. It is such an *obvious* method of procedure! The salesmen, daily in contact with customers and knowing their wants, their dislikes, may be of inestimable assistance in assuring the success of a product."—W. Hunter Snead, sales promotion manager, Edwin L. Wiegand Co., in *Printers' Ink.*

□ □ □

"Research, besides bringing about all the phenomenal improvements in cars, has expanded the automobile buyer's dollar to more than twice its former size. It was that expansion in the size of the purchaser's dollar which widened out the market for motor cars to such a phenomenal degree, and which thereby made the motor car so universally useful."—T. A. Boyd in *Journal of the Western Society of Engineers.*

□ □ □

"When purchasing machine tools or equipment, it is well to include in the specifications a clause to the effect that other things being equal, preference will be given to the best guarded designs; or better yet, include exact specifications for guarding and thus avoid misunderstanding."—C. B. Auel, manager employes' service, Westinghouse Company.

□ □ □

"Projected new engineering designs will necessitate the development of both new methods and new equipment to get such designs into production. In this respect, particularly, machine tool producers will continue to find that brains and initiative will create a market for their products wherever the user can be shown either a better method of achieving the same result or, on the other hand, a means of lowering production costs."—W. S. Knudsen, executive vice president, General Motors Corp., in *Automotive Industries.*

□ □ □

"What might have become a mechanical means of transportation for a few mechanically able consumers, (the automobile) was visioned and actuated through designing ingenuity to become an integral part of almost everyone's daily life, and through appearance and style to become a factor in reflecting social standing. The synchronization of practical imagination, engineering skill and industrial design made this a reality. Industry is now in the position where it must put design to its fullest use to compete in the new scheme for merchandising and selling."—Ben Nash, industrial designer.

Automobiles Employ Zinc Castings

BETWEEN 25 and 30 pounds of zinc in the form of castings and rolled material is used in the average automobile today, and in some cars the amount runs as high as 60 pounds. This was revealed during the round table discussion conducted by the Institute of Metals division of the American Institute of Metallurgical Engineers during the meeting of the Metals congress in Detroit recently. W. M. Pierce, assistant to chief of Research, New Jersey Zinc Co., Palmerton, Pa., discussed the redesign of journal bearings for industrial use through the employment of die castings. A spherical shell and bushing make the unit self-aligning. The bushing is a die casting with a bronze insert as the bearing.

Multiple V-Belt Drive Announcement

ALLIS-CHALMERS Manufacturing Company, of Milwaukee, Wisconsin, announces that licenses under United States Letters Patent No. 1,662,511 relating to power transmitting mechanism, commonly known as Multiple V-Belt Drive, have been granted to the following belt and sheave manufacturers:

The American Pulley Company - - - - - - Philadelphia, Pa.
The Dayton Rubber Manufacturing Company - - - - Dayton, O.
R. & J. Dick Co., Inc. - - - - - - - - - - - Passaic, N. J.
Dodge Manufacturing Corporation - - - - - Mishawaka, Ind.
L. H. Gilmer Company - - - - - - Tacony, Philadelphia, Pa.
Goldens' Foundry & Machine Company - - - - Columbus, Ga.
The B. F. Goodrich Rubber Company - - - - - - Akron, O.
The Goodyear Tire & Rubber Company, Inc. - - - - Akron, O.
W. A. Jones Foundry & Machine Company - - Chicago, Ill.
The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc. - - - - - - Passaic, N. J.
The Medart Company - - - - - - - - - St. Louis, Mo.
The Ohio Valley Pulley Works - - - - - - Maysville, Ky.
Pyott Foundry & Machine Company - - - - - Chicago, Ill.
Rockwood Manufacturing Company - - - - Indianapolis, Ind.
T. B. Wood's Sons Company - - - - - - Chambersburg, Pa.
Worthington Pump and Machinery Corporation - Harrison, N. J.

Allis-Chalmers Manufacturing Company

Milwaukee, Wisconsin

NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Thermostat Protects Bearings

FOR protecting motor driven and other types of rotating machinery from breakdowns due to overheated bearings, Electric Controller & Mfg. Co., 2720 East Seventy-ninth street, Cleveland, has announced a new bearing thermostat. The thermostat, shown herewith, is of simple

A rise in temperature of the bearing will generate pressure which acts to shut down the machine

construction and is quite compact. It consists of a sealed metallic bulb containing a volatile liquid which is connected, directly or through flexible copper tubing, to a one-piece seamless metal bellows. The electrical contacts are silver and are of double break, quick make and quick break construction. A rise in temperature of the bearing of a rotating machine causes the volatile liquid to expand and generate pressure in the bulb. This pressure in turn, is transmitted to the bellows, causing the contacts to open and shut down the machine. Proper operation of the thermostat is obtained with the bulb or relay installed in any suitable position; upright, horizontal or inverted.

Screw Steel Is Improved

AN IMPROVED bessemer screw steel involving mainly a radical improvement in its free-cutting quality has been announced by Jones & Laughlin Steel Corp., Pittsburgh. This steel is made in both S.A.E. 1112 and high-sulphur grades with chemical and physical properties unchanged from the steel which it superseded. In addition to there being no change in the chemical specifications nor in the physical properties of the improved steel, the grain structure has not been altered nor has response to carburizing treatments been affected by the bettered machining quality.

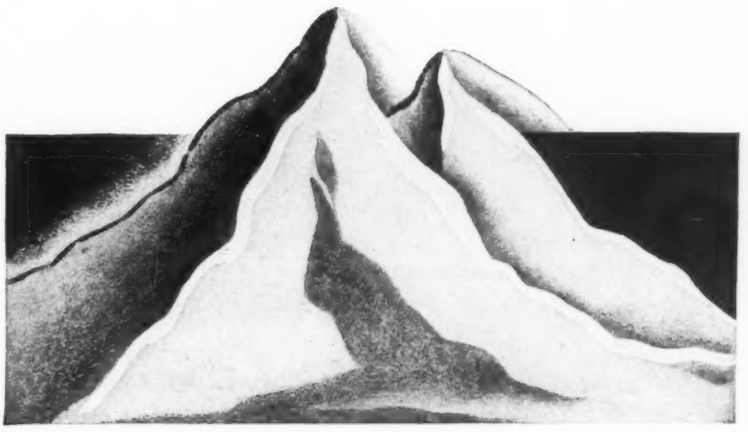
Splash-Proof Motors Are Developed

BUILT with heavy solid cast frames and with special cast end bells, solid except for the fan-shaped air duct with openings at the bottom just slightly above the motor feet, the new splash-proof motor developed by Fairbanks, Morse & Co., 900 South Wabash avenue, Chi-

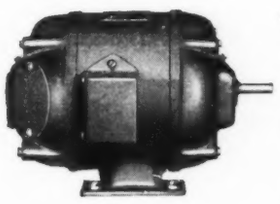
Special end bells prevent water from reaching windings of the motor

cago, is suitable for use wherever the motor might be exposed to splashing, falling or dripping water, steam, falling particles, etc. The air ducts in the end bells are provided with removable, perforated baffles which protect the motor from water splashing directly into the air duct, yet provide ventilation for the motor.

To protect the bearings against a high pressure stream of water directed at them along the shaft, a water deflector consisting of a simple ring around the shaft is supplied. This deflector can be removed if a pulley or coupling is installed adjacent to the bearing housing. The mounting dimensions of the motors, shown herewith,



AT THE PEAK...



Every motor bearing the Century name-plate is at the peak of today's design and engineering skill. That's why Century so continually and successfully meets the exacting demands of progressive engineers and designers. These men know the sales importance of selecting the right motor. They know it has paid them to consult Century.

CENTURY ELECTRIC COMPANY
1806 Pine Street ' ' ' St. Louis, Mo.
Offices and Stock Points in Principal Cities

Century
MOTORS

are the same as the standard open type motors built according to NEMA standards except where the water deflector on the shaft is used.

Vertical Drive Bases Announced

VERTICAL drive bases which provide for and maintain the correct belt tension on both pulleys have been developed by the Rockwood Mfg. Co., Indianapolis. As in all drives manufactured by the company, the motor is suspended from a pivot shaft, but in this adaptation the weight of the motor is counterbalanced by two coiled springs connected by rods to the bracket

Correct belt tension on both pulleys is maintained by vertical motor base

arms, rather than by the weight of the motor. These springs are adjustable for belt tension.

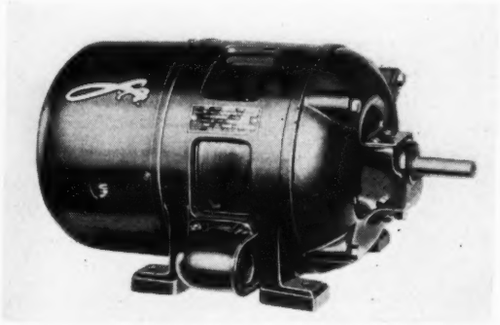
The pivot shaft of the base is movable vertically by means of convenient adjusting screws. The base permits the machine operator to set the belt tension to match each change in work. When the motor is located above the driven pulley, the springs are adjusted to support the entire motor weight plus the necessary belt tension. When the motor is located below the driven pulley, the springs are adjusted to support only that portion of the motor's weight not needed to provide belt tension.

Another recent development of the company is a ceiling base that is quite similar to the standard base excepting that it has special hanger arms which suspend the motor horizontally.

Motors Have Capacitor Built In

CAPACITOR start, single phase motors which have a built-in capacitor and an automatic cut-out switch have been designed by Louis Allis Co., Milwaukee. The capacitor is of the coil wound type without any sharp turns and is so located that a stream of cooling air passes constantly between the motor and capacitor so that motor heat is not radiated to the capacitor.

The automatic centrifugal switch cuts out the capacitor at the speed chosen and is not affected by voltage variations or starting load variations. The motors are available in sizes ranging from

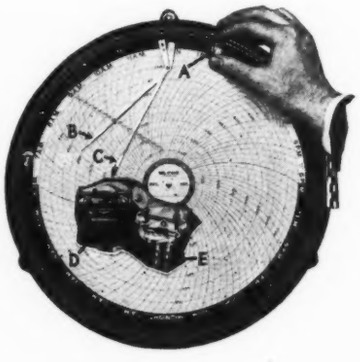


Coil wound capacitor is built into the motor frame to form compact unit

one-third to three horsepower in either horizontal or vertical types. Other sizes are to be added to the line.

Controllers Maintain Temperature

MERCURY switches are used to eliminate open make-and-break contacts on the new automatic control thermometer announced by Brown Instrument Co., Philadelphia. In this controller, shown herewith, a motor-driven control table determines the location of the pen on the chart in reference to the control setting every six seconds, and tilts the mercury switch from one side to the other if the temperature has changed. This control mechanism is adaptable to one, two, or three-contact control (or signalling) systems. In a two-record controller,



Electric motor, D, selects switch position, depending upon relation of C to B. Adjusting of index B, showing temperature at which control is set, is accomplished through knob A

each control mechanism can control a separate device, each may be used independently of the other, and each has its own control index.

The unit also is supplied as a time-temperature

TOUGH *by any test*

● If toughness after heat treatment is a vital requirement in your steel, then Carnegie Controlled Carbon Steels warrant your investigation. Through positive control of quality factors in their manufacture, the scope of these steels in all carbon ranges now includes many uses heretofore requiring higher priced alloys. One user reports that he has not only reduced his steel costs but in addition has cut his processing costs 11%.

Let our metallurgists help you to determine the grade and character of steel best suited to your purpose. Once this has been developed, you may be sure that every succeeding heat will respond to your process in an equally satisfactory manner. This is accomplished through scientific control of metallurgical practice, including control of austenitic grain size heretofore believed by many as impossible in basic open hearth steels.

The booklet "Carnegie Controlled Carbon Steels" will be sent you upon request.

CARNEGIE STEEL COMPANY • PITTSBURGH

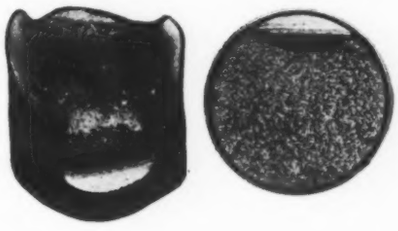
240 Subsidiary of United States Steel Corporation

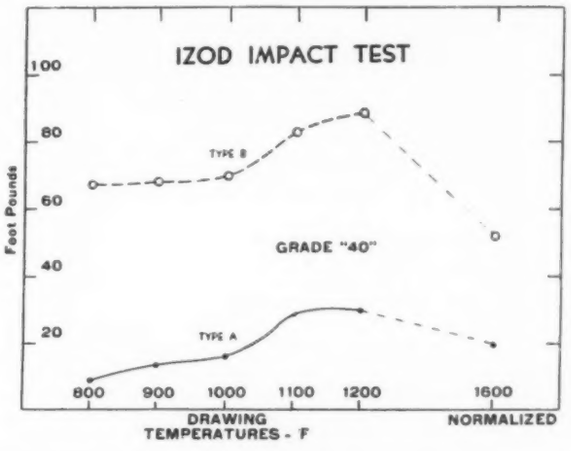
DISTORTION TEST

TYPE B TYPE A

These tests compare two .40 carbon steels of same analysis and identical treatments.

FRACTURE TEST





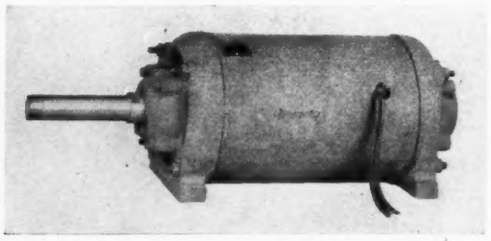
ENDURANCE LIMIT—R. R. Moore machine in air,
Grade .50 Type A 66,500 pounds per square inch
Type B 71,000 pounds per square inch

CARNEGIE
Controlled
CARBON STEELS

cycle controller. A transparent cam placed over the chart is used to shift the control index in relation to time. As the cam rotates with the chart, the control point is moved to new positions, depending upon the shape of the cam. A different cycle of control operations can be obtained by cutting a new cam.

Arbor Motors Are Self-Ventilated

A COMPLETE line of enclosed self-ventilated arbor motors ranging in size from 2 to 10 horsepower has been placed on the market

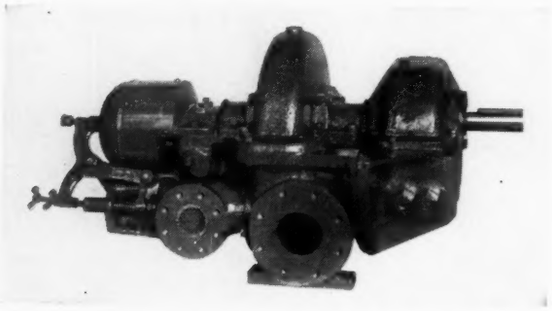


Arbor motors are adaptable to application where space is limited

by Louis Allis Co., Milwaukee. These motors, shown herewith, are especially adaptable for applications where the available space for mounting is limited.

Introduces Turbine-Gear Sets

CLOSE coupled, turbine-gear sets in a new line, each set consisting of a steam turbine and speed reducing gear, have been announced



Correct alignment is provided for turbine and gear by bolting housings together

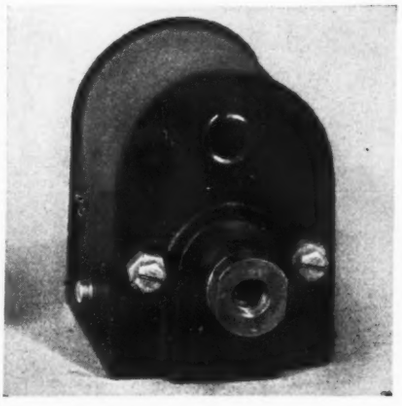
by General Electric Co., Schenectady, N. Y. These new equipments are designed to drive centrifugal pumps, fans and other relatively low speed apparatus by means of the speed reducing gear, the turbine operating at a relatively high and efficient speed. The sets are particularly applicable where exhaust steam can be used for heating purposes, such as milk drying machines. Operation is extremely simple and the sets are self-lubricated.

The housings of the turbine and gear are bolted together to form a single structure supported on the base of the turbine. This arrangement provides a correct alignment of turbine and gear. The turbine can be arranged to operate at steam pressures up to 400 pounds, temperatures up to 750 degrees Fahr., and back pressures up to 40 pounds gage. The speed of the low speed shaft may be within the range of 180 to 3000 revolutions per minute. Capacity of this new line of turbine-gear sets ranges from 10 to 150 horsepower.

Valves Give Precise Control

AN ELECTRICALLY operated check valve for handling compressed air and liquid mediums has been developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This fluid valve, shown herewith, is capable of handling both small and large volumes.

Besides being used to control the supply of



Check valves can be used to control the supply of liquids and will handle both large and small volumes

hot or cold water, gases of various kinds, oil for hydraulic machines, gasoline or compressed air, the valve can be connected in the ignition circuit in such a way that cutting off the ignition switch will close the valve, thus cutting off the supply of gasoline. Similar installations in other fields are possible.

Material Available in Many Colors

PRODUCED in all colors from translucent colorless natural and white to lustrous black, Plaskon, a heat-hardening plastic for hot molding compounded from synthetic nitrogeneous

Folks—

This is a sidebar from one link in a Baldwin-Duckworth Roller Chain. The same scrupulous care goes into the selection of material, the accurate machining and vigilant inspection that each unit of every Baldwin-Duckworth Chain undergoes.

This straight type sidebar is made of alloy steel and uniformly heat treated. The holes in the sidebars are accurately broached to size and true to pitch; their holding power firmly grips the pins and bushings.

Baldwin-Duckworth Roller Chain Drives offer many advantages that appeal to those interested in efficiency and economical power transmission. They are positive in action, cannot slip, and will operate at an average efficiency of 98.5%.

Properly selected roller chains will fulfill almost any normal power transmission requirement. They may be run at from a fraction of one revolution per minute as in a conveyor drive, up to relatively high speeds as in electric motor drives.

Our engineers will be glad to consult with you on your special requirements for

NRA MEMBER U.S. WE DO OUR PART

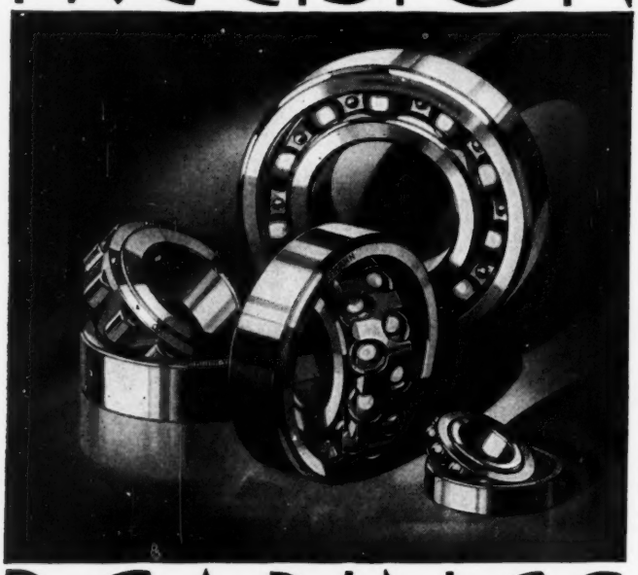
DEPENDABLE DRIVES FOR EVERY PURPOSE

BALDWIN-DUCKWORTH CHAIN CORP.

SPRINGFIELD, MASSACHUSETTS

FACTORIES AT SPRINGFIELD AND WORCESTER, MASSACHUSETTS

PRECISION



BEARINGS

PRECISION—as the term defining the characteristics distinctive of NORMA-HOFFMANN Bearings—comprehends ALL those qualities which reveal themselves in higher anti-friction efficiency, greater speed-ability, better performance, longer life, fewer replacements, improved production. ✡ ✡ ✡ These are the definite and tangible gains which accrue to the builder and user of any machine in which NORMA-HOFFMANN PRECISION Bearings are incorporated. ✡ ✡ ✡ Write for the PRECISION Bearing Catalogs. ✡ ✡ ✡ Let our engineers work with you—without obligation.

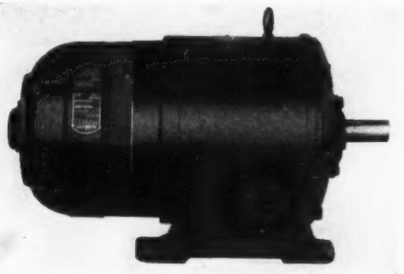
"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST

NORMA-HOFFMANN BEARINGS CORP., STAMFORD, CONN., U. S. A.

resins, filler, pigments, mold lubricant and softening agents is now being marketed by Toledo Synthetic Products Inc., Toledo, O. The material is usually supplied in granular form. The fabricated product has a specific gravity of 1.48 compressive strength of 25,000 to 30,000 pounds per square inch; tensile strength of 4000 to 6000 pounds per square inch; and is unaffected by alcohol, acetone, oils, gasoline or other common organic solvents.

Geared Motors Are Available

GEAR motors capable of providing speeds from 2 to 4000 revolutions per minute in capacity sizes from ¾ to 75 horsepower have been announced by Fairbanks, Morse & Co., 900 South Wabash avenue, Chicago. Three separate types known as the integral gear motor, shown herewith, the all-motor type gear motor and the geared head type gear motor have been produced to meet the various requirements of application.



Motor frame is supported from the gear housing in integral gear motor

In the integral type of gear motor the motor frame is supported from the gear housing, thus eliminating the motor base. The motor and gear reducer are coupled by a bayonet-type joint between the stator frame of the motor and the mounting ring of the gear housing. The all-motor type unit permits the use of a standard horizontal motor for which the gear housing is extended to form a bedplate for mounting. In the geared head type unit the gear attachment is supported from the motor frame and a rigid connection is afforded between the stator frame of the motor and the gear housing.

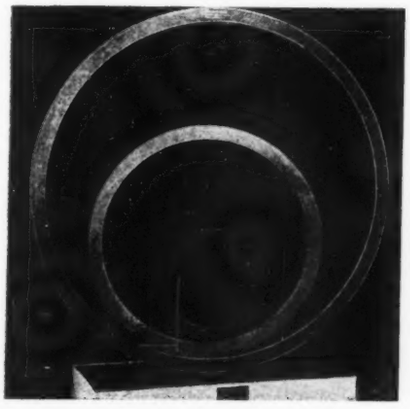
Electric Outlet Is Weatherproof

A WEATHERPROOF outlet that will facilitate the use of outdoor appliances has been added to the line of wiring devices manufactured by the merchandise department of General Electric Co., Bridgeport, Conn. Made of brass and cadmium coated, the outlet resists rust and

corrosion. The flush plate has a solid rubber pad mounted on the back, insuring a snug fit when the device is screwed in place. A cap slips over the cord plug and screws on to the device, assuring a weatherproof connection.

Bearing Material Takes Greater Loads

MICARTA in a new grade, known as No. 1C17, has been developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., for the radial part of roll neck bearings on severe applications. Grade 863, which is similar in texture, is being used for thrust plates on all bearings. It can be machined or sawed to any desired shape. This grade of material for radial lines can stand higher thrust loads and pressures without dislamination or splitting.



New grade of Micarta for use as the radial part of roll neck bearings can be machined or sawed to any desired shape

Manufactures One-Way Clutches

THE Kelpo free wheeling or one-way industrial clutch has been acquired by Morse Chain Co., division of Borg-Warner Corp. This clutch, formerly a product of Kelpo Clutch Co., Rockford, Ill., will be manufactured at the Ithaca plant of the Morse Company and will be sold by Morse Chain Co. representatives.

FROM the X-ray field emanates word of the smallest set ever built. Demonstrated at the recent meeting of the American Congress of Radiology at Chicago, the set is rated at 58,000 volts and 10 milliamperes, a marked contrast to the mammouth 800,000-volt X-ray equipment recently placed in a Chicago hospital. The device operates from an ordinary light socket and is capable of making X-ray photographs of the entire human body. Moreover, it may be carried around and used for making fluoroscopic examinations in industrial plants. The General Electric X-ray Corp. developed it.

MACHINES*

of all types are designed by Executives and Engineers who read Machine Design

Adding machines
Addressing and mailing machines
Agricultural machinery
Aircraft
Bakers' machinery
Baling presses
Blowers and fans
Bookbinding machinery
Bottling machinery
Calculating machines
Canning machinery
Card-punching and tabulating machines
Cars and trucks
Cash registers
Cement and concrete machinery
Change making machines
Check writing machines
Clay working machinery
Clothes pressing machines
Coffee roasting and grinding machines
Condensers
Confectionery and ice cream machinery
Conveying machinery
Cotton gins
Cranes, including hoists and derricks
Dairy machinery
Dish washing machinery
Dredging and excavating machinery
Electrical machinery
Elevators and elevator machinery
Engines, steam and internal combustion
Fare registers and boxes
Flour mill and grain mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass making machinery
Hat-making machinery
Hydraulic machinery
Incandescent lamp making machinery
Laundry machinery
Lawn mowers
Leather working machinery
Locomotives
Machine tools
Manifolding machines
Metal working machinery
Meters, gas and water
Mining machinery
Miscellaneous and special machinery
Motion picture cameras and projectors
Motorcycles and bicycles
Motor vehicles
Oil-mill machinery
Oil-well machinery
Ore crushers
Packaging machines
Packing house machinery
Paint making machinery
Paper box machinery
Paper mill and pulp mill machinery
Pharmaceutical machinery
Photo-engraving machinery
Pneumatic machinery
Printing machinery
Pumps and pumping machinery
Refrigerating and ice making machinery
Road making machinery
Rolling mill machinery
Rubber working machinery
Scales and balances
Sewing machines
Shoe machinery
Slicing machines
Slot vending machines
Stokers, mechanical
Stone working machinery
Sugar mill machinery
Textile machinery
Tobacco manufacturing machinery
Transmission machinery
Typewriters
Vacuum cleaners
Washing machines, ironing machines
Welding machines
Well-drilling machinery
Windmills and towers
Woodworking machinery

***Machines as classified by the United States Census Bureau**

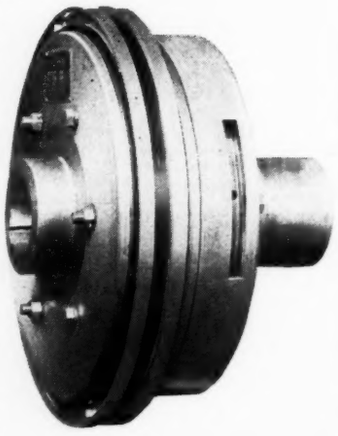
Gear ratios 1089:1 to 36:1. Shaft speeds 4 to 300 R. P. M.

DUMORE Fractional Horsepower Motors are made with built-in gear reduction units. They combine the advantages of light weight, controlled speed and smoothness for low speed applications. Will operate on A. C. or D. C. Write for complete information.

THE DUMORE COMPANY, 100 Sixteenth St., Racine, Wis.

DUMORE
MOTORS

NEW . . . STEARNS Safety Type Magnetic Clutch



This clutch is the first of its type to employ the Magnetic brake principle of operation. It is mechanically closed by powerful springs and opened magnetically in opposition to these springs. Standard Magnetic clutches are closed magnetically and opened mechanically . . the reverse of this safety type clutch.

For continuous clutch engagement and infrequent disengagement, this new Stearns Clutch offers advantages in economy of current consumption, positive clutching action, independent of current, and the usual Magnetic clutch features of smoother acceleration, automatic control, low maintenance cost. Write for complete information.

MAGNETIC MFG. COMPANY
651 Dept. TL-S. 28th St. Milwaukee, Wis.

HIGH STEARNS DUTY

Noteworthy Patents

(*Concluded from Page* 44)

ancer sections with corresponding interfitting ledges 28 whereby the abutment body is shouldered to its seat. Excessive strain consequently is removed from the bolts and displacements guarded against. When the balancer is assembled on the crankshaft, springs 25 are loaded as indicated in the drawing, which shows the springs bent or cambered by pressure of abutment bearings 24.

A sufficient number of plates or leaves should be assembled in each spring 25 to enable it, when properly adjusted as to initial load, to impart to the balancer assembly a natural frequency of vibration which will balance out the vibrations of the crankshaft vibrating at its natural frequency.

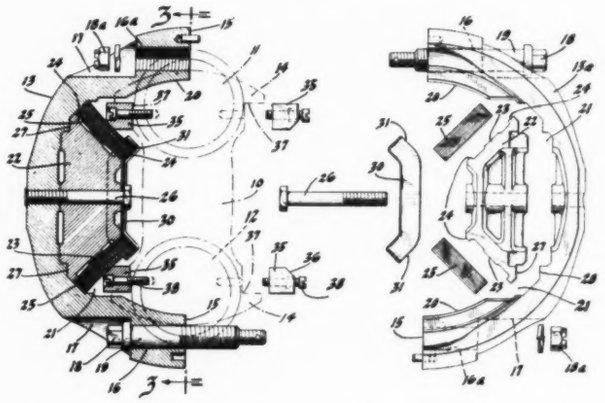


Fig. 5—Component parts of vibration eliminator designed for use as crankshaft balancer

Number 1,929,797 identifies the patent.

SPRING CONNECTION—1,935,957. The invention embodies a spring end connection which employs an antifriction bearing member. Fafnir Bearing Co., New Britain, Conn.

CUTTING MECHANISM—1,934,997. A machine for cutting a continuously formed length of moving material into predetermined lengths is covered by this patent. Assigned to Stone Straw Corp., Washington, D. C.

MILKING MACHINE—1,935,870. This patent covers a milking machine comprising a pump with a reciprocating piston, means for operating the piston with a suction stroke of relatively long duration and a discharge stroke of short duration with substantially no interval between the strokes. The inventor is Albert Blatz Jr., Milwaukee, and Pioneer Mfg. Co. is assignee.

Business Announcements and Sales Briefs

ALLIS-CHALMERS MFG. CO., Milwaukee, has issued a number of licenses to manufacture on a royalty basis its multiple V-belt drives, designed and developed by Walter Geist, general representative in charge of the belt drive division. The licensed manufacturers have organized as the Multiple V-Belt Drive association with Mr. Geist as president.

* * *

A. V. Grove has been transferred from the Cleveland office of Steel & Tubes Inc. to the Chicago office. J. F. Keeler is now sales engineer with the company with headquarters at the Cleveland office.

* * *

Westinghouse Electric & Mfg. Co. has moved its New York sales and executive offices to the RCA building, 30 Rockefeller Plaza, New York.

* * *

Fred M. Potgieter, formerly president of Kelpo Clutch Co., has joined the Morse Chain Co., Ithaca, N. Y.

* * *

E. Akridge and Geo. E. Popelar have been appointed Chicago sales engineers with Foote Bros. Gear & Machine Co., Chicago.

* * *

E. F. LeNoir has been appointed representative of Louis Allis Co., Milwaukee, with headquarters at Allentown, Pa. Mr. LeNoir was formerly president of Union Electric Mfg. Co.

* * *

Roger H. Clapp has been appointed Pacific Coast sales manager of the Wickwire Spencer Steel Co., with headquarters in San Francisco. The company also has reestablished its branch office in Los Angeles with Ben Scott in charge.

* * *

Hugh L. Rusch has been elected vice president and appointed eastern sales manager for Northern Pump Co., Minneapolis. In the East the company has offices in New York, Philadelphia, Boston, Pittsburgh and Buffalo. Eastern headquarters are in the Chrysler building, New York.

* * *

Tyson Roller Bearing Corp., Massillon, O., through its representative in England, has been granted a patent by the British government on the cageless tapered roller bearing. The company previously had been granted patents in the United States, Canada, Belgium, Czecho Slovakia, Sweden, Germany and France.

* * *

H. Boker & Co. Inc., 101 Duane street, New York, now represents the following companies as distributors: American Rolling Mill Co., stainless steel sheets; Simonds Saw and Steel Co., stainless steel rods, plates and strips and chrome and chrome-nickel alloys; and Michiana Product Corp., heat and corrosion resisting cast and fabricated alloys.

* * *

Ex-Cell-O Aircraft & Tool Corp., Detroit, has appointed John E. Figner representative in the Pittsburgh territory.

* * *

Bundy Tubing Co., Detroit, has moved its offices and factory to 10951 Hern avenue.

* * *

Eddie Phillips has joined Tyson Roller Bearing Corp., Massillon, O., as field sales engineer.

* * *

The management of the Birmingham office of Chain Belt Co. is now in charge of the sons of Samuel Rynn Morrow Sr., former manager who died recently.

* * *

E. R. Wegener has been appointed Michigan representative of the cold-drawn bar steel division of the Western Automatic Machine Screw Co., Elyria, O., with headquarters at 510 Stephenson building, Detroit.

* * *

Theodore L. Dodd & Co., 80 East Jackson boulevard, Chicago, has been appointed western sales representative of A. H. Wells & Co. Inc., Waterbury, Conn., manufacturer of seamless brass, copper and bronze tubing.

* * *

Louis Allis Co., Milwaukee, has announced the appointment of four new members of their sales organization as follows: C. F. Cate, 212 North Third street, Albuquerque, N. M., as representative for the state of New Mexico; Robert B. Soderberg, 196 Palm street, Hartford, Conn., as representative for the state of Connecticut; N. O. Lawyer, Room 385, 50 Church street, New York, as an additional sales representative for New York city; and G. W. Conner, 1124 Chamber of Commerce building, Cincinnati, as a member of the Cincinnati sales force.

ENGINEER WANTED

EXPERIENCED HYDRAULIC ENGINEER, capable of designing hydraulic presses, pumps and valves; with sales ability. State age, experience and salary.

Address

Hydraulic Manufacturer,
c/o Machine Design,
1213 West Third Street,
Cleveland, Ohio.

ALLOYS (STEEL)—Republic Steel Corp., Massillon, O., has prepared an attractive booklet on the new Enduro 4-6 per cent chromium steels. These steels possess resistance to corrosion, acid attack, and scaling at elevated temperatures. They can be rolled, formed, drawn, forged, welded or riveted into almost any shape desired and are available as sheets, plates, hot and cold rolled strip, bars and other usual forms.

ALUMINUM—Aluminum Co. of America is distributing a new book entitled "Alcoa Aluminum for Truck Bodies," which includes considerable engineering information on the application of the material to this service, suggested designs for various types of truck bodies and case histories. The booklet is supplemented by construction drawings printed on paper suitable for blueprinting.

BASES—Rockwood Mfg. Co., Indianapolis, has prepared circulars describing its new bases designed for maintaining correct belt tension. These new parts are a vertical base suitable for inclusion in the design of the machine to be driven and a ceiling base.

BEARINGS—Bulletin No. 339 of Johnson Bronze Co., New Castle, Pa., includes a complete listing of the company's standard stock sizes of phosphor bronze bushings ready for machine assembly. The bulletin also includes data on universal machined bars, cored bars, solid bronze bars, hexagon bars and graphited bronze bushings. Bulletin EM-4 of the company includes a listing of electric motor service bushings for all makes of motors.

COMPOSITION MATERIALS—A new 8-page booklet entitled "The Durez Primer," which illustrates and explains seven different applications for synthetic products has been published by General Plastics Inc., North Tonawanda, N. Y.

COMPOSITION MATERIALS—The use of Haveg, a corrosion resistant material made with an asbestos base combined with a special phenol-formaldehyde type of resin, in chemical equipment is illustrated and explained in a recent bulletin of Haveg Corp., Newark, Del. The bulletin describes the material and outlines actual applications as parts in many divisions of the chemical equipment field.

COMPOSITION MATERIALS—Toledo Synthetic Products Inc., Toledo, O., has prepared a booklet giving technical data on Plaskon, a heat-hardening plastic for hot molding compounded from synthetic nitrogenous resins, filler, pigments, mold lubricant and softening agents. The booklet includes data on the properties of the material, molding conditions and types of molds.

COMPOSITION MATERIALS—Of special interest to those engineers who consider the production problems in-

PROOF OF SATISFACTORY SERVICE—REPEAT ORDERS

Biscuit Co.

September 22, 1931.

Lewellen Manufacturing Company,
Columbus, Indiana

Gentlemen:

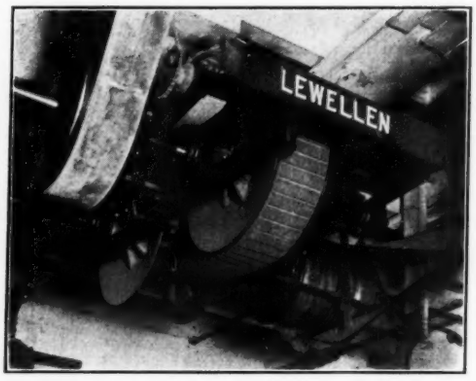
Eight years ago today we installed a size thirteen Lewellen Transmission and have used it continuously, running it eight hours or more per day, and we are so well pleased with same that it is a pleasure for us to write you this letter.

In the entire eight years we have not had one minute's trouble and have not spent one cent for parts. We are still operating it with the same belt that came with the machine. All we have done is used it and gave it a little oil every few months.

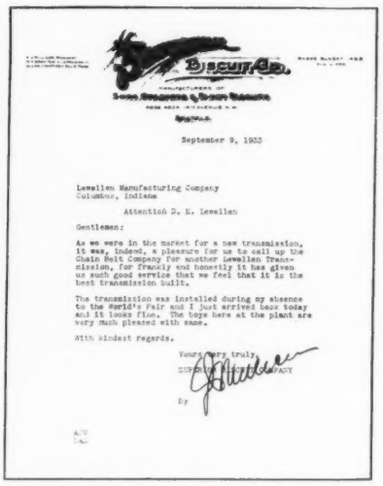
It is sure a wonderful machine.

Very truly yours,
Biscuit Co.
By

AJW-L



This Lewellen Variable Speed Transmission was installed at Superior Biscuit Co., Seattle, Wash. in 1923. Eight years later they express entire satisfaction with its service.



Biscuit Co.

September 9, 1933

Lewellen Manufacturing Company
Columbus, Indiana

Attention D. E. Lewellen

Gentlemen:

As we were in the market for a new transmission, it was, indeed, a pleasure for us to call up the Chain Belt Company for another Lewellen Transmission, for frankly and honestly it has given us such good service that we feel that it is the best transmission built.

The transmission was installed during my absence to the World's Fair and I just arrived back today and it looks fine. The boys here at the plant are very much pleased with same.

With kindest regards.

Yours very truly,
By

Not a cent for repairs in eight years! The sincerity of this letter above is proven by their letter on the right, when they ordered their second unit.

Ten years of trouble-free service brings their verdict—a repeat order. Can we add anything to this proof of Lewellen efficiency? Send for catalog.

THE *Lewellen* MANUFACTURING CO.
COLUMBUS, INDIANA
"It costs no more to have the best"

volved when designing a part is the recent folder issued by Synthane Corp., Oaks, Pa., which gives in convenient chart form for ready reference complete instructions for machining laminated bakelite. The folder also includes a table giving characteristics for eight grades of the material.

COUPLINGS—Three different types of flexible shaft-couplings are described in a new illustrated catalog of Link-Belt Co., Indianapolis, which gives special emphasis on type RC which employs roller chain for flexibly connecting the two toothed coupling halves. Selection of the proper coupling is facilitated by a series of conveniently arranged tables.

DIE CASTINGS—Aurora Metal Co. Inc., Aurora, Ill., has prepared a new bulletin, No. 4, descriptive of aluminum bronze die castings entitled "For Metal Parts in Modern Products." The bulletin describes the parts, includes photographs of applications, and gives the composition and characteristics of the material used.

DRIVES—Multi-speed reducers designed to give a variation in speed and a reduction in speed at the same time are described in a leaflet of Davis & Thompson Co., Milwaukee. The drive units have a motor built into the case to provide an integral, compact unit.

MOTORS—Louis Allis Co., Milwaukee has published bulletin No. 514 which illustrates and describes the company's new line of capacitor start, single phase motors which have the capacitor built in and include an automatic cut-out switch.

MOTORS—The complete line of Crocker-Wheeler Electric Mfg. Co., Ampere, N. J., is reviewed in a recent booklet of the company. The booklet includes data on alternating current motors, direct current motors, generators, motor generator sets, speed changers, flexible couplings and the torquemeter.

MOTORS—The application of totally enclosed, fan cooled motors to machine tools is covered by bulletin 174, part 7 of Wagner Electric Corp., St. Louis. Discussed in the bulletin are applications of these motors to honing, milling, drilling, reaming, tapping, threading and grinding machines, from the smallest to the largest sizes.

MOTORS—The engineering department of Louis Allis Co., Milwaukee, has prepared a comprehensive application chart showing 29 different types of motors for use on alternating and direct current and listing the proper motor for over 50 different standard applications. The chart shows standard ratings, starting torque, maximum torque and speed regulation.

WELDED PARTS AND EQUIPMENT—Hobart Bros. Co., Troy, O., is distributing a new 12-page booklet, D-7, on the arc welding of copper to copper and copper to steel. The booklet contains complete instructions for applying the newly developed "Long Arc" method of welding.

STEEL BARS—Union Drawn Steel Co., Massillon, O., has prepared a folder which describes the procedure used in the plant of the company to secure commercially perfect steel bars. Applications of the bars in industry are presented.

ALLEN

TRI-MARK

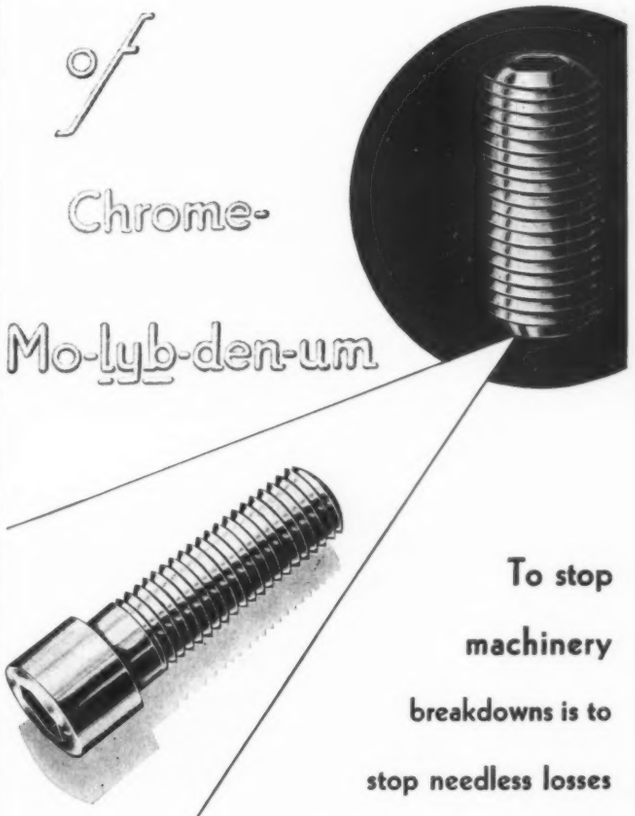
TRADE MARK

HOLLOW SCREWS

of

Chrome-

Mo-lyb-den-um



To stop machinery breakdowns is to stop needless losses on close-figured jobs

PROFIT-making machinery runs fast; production tie-ups are profit break-ups; interruptions don't pay because customers won't pay ENOUGH. Continuity of operation comes first in any consideration of Hollow Screws. It's first consideration, too, in making Allen screws of CHROME-MOLYBDENUM. . . Engineers and production men specify Allen screws *of this steel*—heat-treated, cold-worked by Allen processes into products of steadfast performance. » » »

THE ALLEN MFG. COMPANY

HARTFORD, CONN. U.S.A.

A Simple Statement about a Simple Principle

To our knowledge . . . the Viking Rotary Pump employs the simplest principle of any pump on the market. It has "Just Two Moving Parts." There are no springs, no valves nor tricky mechanisms to stick, break or get out of order.

In the simplicity of its design rests the secret of Viking's success. Because of "Just Two Moving Parts" . . . it requires less power to operate . . . there is less friction and wear with a consequent longer life, that is free from repair and service expense. Pump buying is comparatively simple by deciding on the purchase of the extremely simple VIKING. Write today for FREE Folder and Prices.

VIKING PUMP COMPANY
Cedar Falls, Iowa

VIKING ROTARY PUMPS

CB

It is simple—easy—to make BLACK AND WHITE positive prints directly from your originals—without the use of a negative! The NEW No. 2836 Motor-Driven BW DEVELOPING MACHINE can be used by anyone having blueprinting equipment. Just introduce exposed paper into this machine—it comes out as a fully developed positive—no washing or drying. Machine is quality product throughout—yet sells for amazingly low price of $57.50 (slightly higher west of Rockies). Write for complete information.

Charles Bruning Company, Inc.
Since 1899

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of

Iron, Steel and Nonferrous Alloys

Are Available

Per copy, 25 cents. For single copies send cash with order to eliminate cost of billing. Discounts on quantity orders.

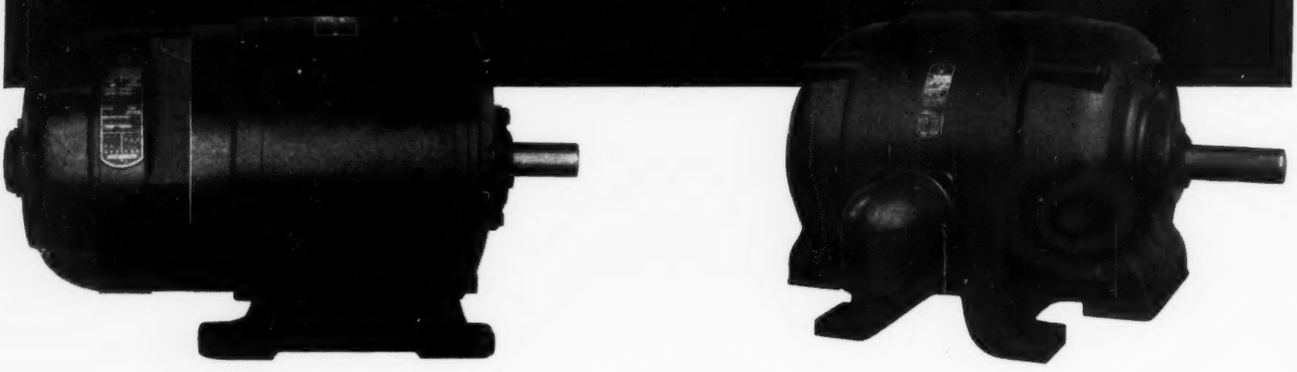
MACHINE DESIGN
Penton Bldg. Cleveland, O.

Reprinted from
December 1932 Issue of
"Class & Industrial Marketing"

THERE is a rumor going around that even with a Democrat in the White House some machines will be sold in the next four years and that new and improved machines are being, and will be, designed.

MACHINE DESIGN
PENTON BUILDING - CLEVELAND, OHIO
The Johnson Publishing Company
in affiliation with
The Penton Publishing Company

AGAIN!—New F-M Motors give you a Sales Advantage!



GEAR MOTORS

from 2 revolutions per minute up

Where standard motor speeds are too high—where you need a compact, simple, slow speed drive—*there* is where you need a Fairbanks-Morse Gear Motor.

The F-M Gear Motor is the same high quality F-M Ball Bearing Motor with standard NEMA frame, built integrally with a 97% efficiency speed reducer which is also equipped with anti-friction bearings.

Either motor or gear assembly may be removed for inspection or repair *quickly*—and re-alignment is positive and accurate due to an indexed fit between the two units.

Cost is considerably less than the conventional motor, coupling and gear box assemblies.

Complete information mailed immediately on request.

SPLASH-PROOF MOTORS

Protected Against All Liquids and Falling Particles

Something new in practical design of splash proof motors—and far superior to the usual "adaptation" to this kind of service. From its very beginning the F-M Splash Proof Motor was designed to be what it is named—*splash proof*—fully protected against steam, water or other liquids which may be directed toward it and against all falling particles.

The only openings are the flared air ducts which open at the bottom slightly above the level of the motor feet.

These air ducts are fitted with removable, perforated baffles which prevent the entrance of any water which may be directed into them.

The design of these baffles is such that resistance to air is negligible. Cooling air is equally and thoroughly distributed, resulting in a sweet running motor with no "hot spots."

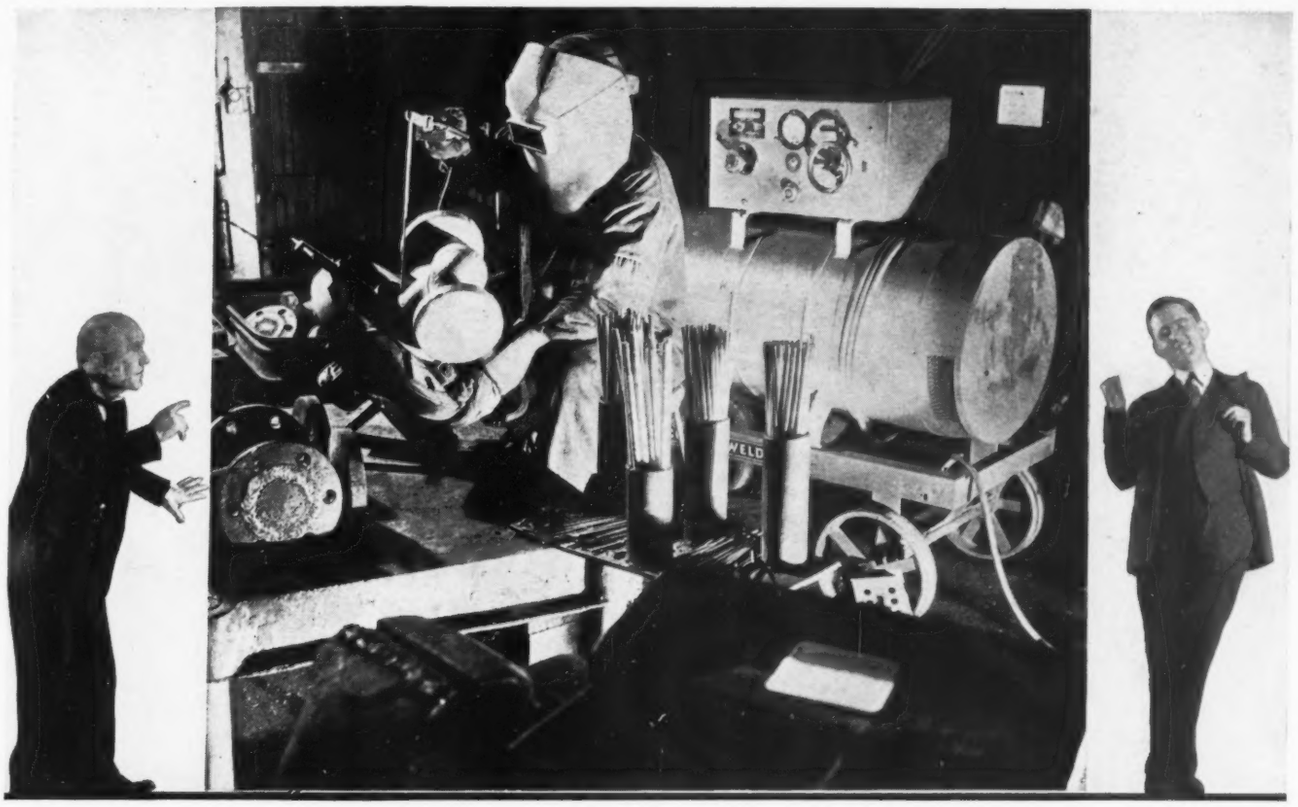
Want to read all about a truly Splash Proof Motor? Send for descriptive bulletins just off the press. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Illinois.

FAIRBANKS-MORSE MOTORS

POWER PUMPING AND WEIGHING EQUIPMENT

5976-EA 40.57

SHIELDED ARC WELDING IMPROVES EDWARD VALVES . . .



"Here, Lad, is where they fuse extra quality, extra strength and extra safety into Edward valves. It's done by welding with a shielded arc.

"They tell me that thousands of Edward valves of various types have been produced by this process. Especially forged steel valves. Under extreme service conditions, they stood up successfully."

What's NEW in Welding!

PROCEDURE HAND BOOK OF ARC WELDING DESIGN AND PRACTICE

434 pages, $1.50—Write for description

"Of course Edward valves stand up. They're using Lincoln *'Shield-Arc'* welders and that means a uniform welding current and high capacity. Those are two of the essentials of production line welding.

"The *'Shield-Arc'* provides all the other essentials too. That's why the super likes it as well as the welder operator. And why the cost accountant likes it as well as the super.

"For the same reason Lincoln is able to make this 3-way guarantee:

1. More weld metal deposit per K. W. H.
2. Faster welding per K. W. H.
3. Lower cost per unit of welding—the unit being per lineal foot of weld, or per pound of weld metal, or per hour of welding.

"Whether it's valves or jigs, machine tools or pipe, you can take *'Fleetweld'* electrodes and a *'Shield-Arc'* welder and have a pair that says 'We do our part.' Proof is yours for the asking."

LINCOLN

THE LINCOLN ELECTRIC COMPANY, CLEVELAND, OHIO

Largest Manufacturers of Arc Welding Equipment in the World

W-56

Where Accuracy Cannot Be Trifled With—

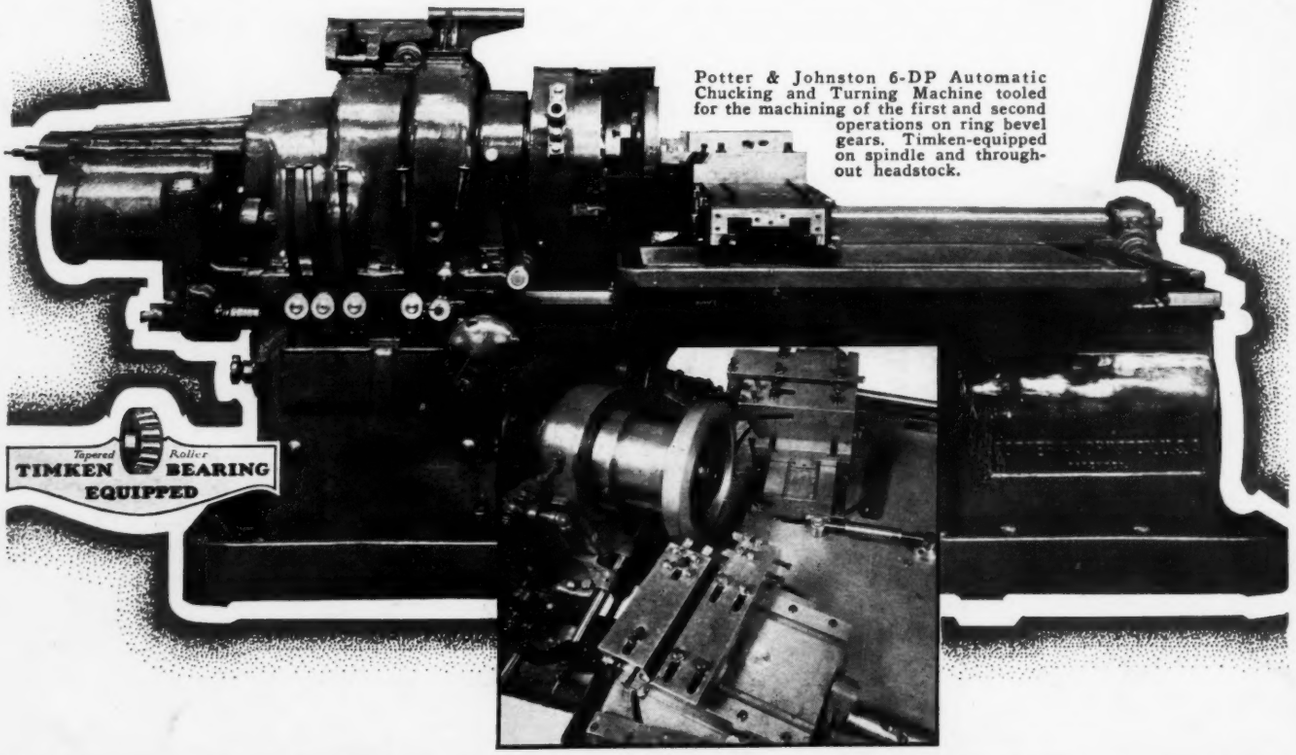
Timken Tapered Roller Bearings

IT takes precision to produce precision. Nothing less than Timken Bearing precision on spindles, in gear boxes and feed mechanisms can satisfy machine tool users who require maximum accuracy in their finished products.

Spindles that run fast and true, without a sign of chatter; transmissions that operate smoothly and silently with correct shaft and gear alignment maintained under all conditions; automatic speed and feed changing mechanisms that are exact to an infinitesimal fraction of a second; are assured by the same exclusive combination—Timken tapered construction, Timken positively aligned rolls and Timken alloy steel.

Furthermore, through Timkens' radial, thrust and combined load capacity, friction elimination and wear resistance this accuracy is preserved for many extra years of dependable service. Specify Timken-equipped.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO



Potter & Johnston 6-DP Automatic Chucking and Turning Machine tooled for the machining of the first and second operations on ring bevel gears. Timken-equipped on spindle and throughout headstock.

TIMKEN *Tapered Roller* **BEARINGS**